E. H. TOOLE

COOPERATIVE VEGETABLE SEED EXPERIMENTS

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By E. H. Toole 1/

When the war in Europe cut off substantial supplies of certain vegetable seeds normally imported by Americans, it was soon evident that the American seed industry was faced with an unprecedented production task. Not only all domestic requirements had to be met, but additional supplies of many important vegetable seeds were needed for export to friendly nations, later our allies.

With the greatly increased requirements of vegetable seed it appeared imperative to obtain definite information on the possibility of extending production into localities and sections of the country not at present being utilized. Expansion in the established districts accentuated problems concerned with cultural practices and disease control.

The Bureau of Plant Industry, Soils, and Agricultural Engineering had been conducting storage and other technical seed studies on a modest scale in anticipation of a national emergency. Soon after the United States was attacked, the Bureau modified its research program in order to greatly expand its work on vegetable seeds and other emergency problems. This was done by suspending or restricting long-time researches on less immediately pressing problems, re-allocating the funds and personnel thus made available, to emergency projects.

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There is as much practical "know-how" in the seed industry in America as anywhere in the world. American seedsmen and farmer growers have stepped up total production enormously. At the same time, it is recognized that this measure of success has often been attained at relatively low efficiency. Partial failures and wide variations in quality harass the producers because of uncontrolled diseases and insects, and because of many other factors almost totally unknown. Heretofore there has been relatively little technical research on vegetable seed production. The commercial seed producers have developed practical methods of handling production in areas developed as seed producing centers but possibilities in other areas have not been extensively explored. During the past two years, however, Federal and State workers, both independently and in cooperation with one another have started a number of studies in efforts to help the industry succeed in reaching the necessary seed production goals.

This is a brief description and progress report on a part of the cooperative work being conducted by the Bureau and several State experiment stations.

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Following preliminary root plantings last year at Cheyenne and Torrington, Wyoming, and Greeley, Colorado, more extensive trials were made this year at several places each in Nebraska, Colorado, and Wyoming. During last summer, roots of carrot, beet, turnip, rutabaga, and parsnip were grown by Dr. M. F. Babb at the Cheyenne Horticultural Field Station and stored in a root cellar there. Through cooperative arrangement made by Dr. Babb with the State Agricultural Experiment Stations in Nebraska, Colorado, and Wyoming, these roots were planted this spring in various possible seed-growing areas in each of these States. Simple plot tests were arranged mainly to test the seed-producing possibilities of prospective new areas for expanding the production of seed of biennial vegetable crops. During the summer these plots were supervised by Mr. Gerald B. Brown of the Cheyenne Horticultural Field Station and records were kept of plant development, blossoming, seed setting and yield.

In Utah, Mr. M. Shapovalov of the United States Department of Agriculture and Dr. L. H. Pollard of the Utah Agricultural Experiment Station arranged for, and started trials last summer in prospective areas in Utah. Seedings of carrot and beet were made at various dates to grow roots to overwinter, both in place and in storage, to test the possibilities of seed production in these areas. Mr. Shapovalov and Dr. Pollard have supervised and kept records of these plots.

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In Idaho, some experimental work on vegetable seed production has been conducted for several years at the Parma Branch Station of the Idaho Agricultural Experiment Station. In the spring of 1943, an expanded program, cooperative between the State Station and Bureau of Plant Industry, Soils, and Agricultural Engineering was undertaken. This is being directed toward solving some of the cultural problems such as use of fertilizers, irrigation and plant spacing, that have arisen in a rapidly expanding vegetable seed producing area. These experiments have been conducted by Dr. M. W. Reger, representing BPISAE and Mr. D. F. Franklin, representing the Idaho Agricultural Experiment Station.

In Arizona, cooperative trials of vegetable seed production are being conducted by Prof. A. H. Finch and Dr. A. M. Griffiths of the State Agricultural Experiment Station in the Salt River Valley and in several of the cooler valleys of the State. This work has already led to seed contracts in that State by several seed companies.

Cooperative work on vegetable seed production in Oregon was started under the supervision of the late Prof. George R. Hyslop with various members of the Oregon Agricultural Experiment Station. Dr. Paul W. Miller of the Bureau of Plant Industry, Soils, and Agricultural Engineering has given special attention to the disease problems involved. The work has included trials in different coastal areas for cabbage seed production, as well as studies of methods of production of carrot and table beet seed. For the coming year, in addition to the experimental tests by public agencies there will be a number of small trial plantings of cabbage for seed by seedsmen in Oregon.

The increasing difficulties with commercial cabbage seed production in the Puget Sound region led to the initiation of investigations on the cultural, disease and insect problems involved, in the spring of 1943. These investigations are conducted under cooperative arrangements among the Washington Agricultural Experiment Station, the Western Washington Experiment Station, the State Department of Agriculture, the State Planning Council, Skagit County, and the United States Department of Agriculture. It is, of course, too early to report on any of the extensive trials that are only now in their first year.

In Wyoming, Colorado, and Utah, trials were widely spaced in each State, in many cases hundreds of miles from headquarters of the supervisor. The labor shortage affected the farmers and superintendents of branch experiment stations who cooperated in caring for the plots, and weather conditions sometimes prevented planting the roots at the time planned. For these reasons the plant development observed and the yield records, which will be available later, may not represent accurately the full possibilities of the different areas. In an attempt to compensate for this, a harvest time inspection trip was made and detailed notes were taken of plant growth, seed set, stage of ripeness, and apparent factors that may have influenced results. Below is a summary of these observations on the trials of seed production of table beet and carrot in Colorado, Wyoming, and Utah.

Table Beet

The trials with table beet were especially promising at Greeley, Colorado, and at Cody, and Wheatland, Wyoming. At Worland, Wyoming, results were satisfactory but slightly less promising. Growth of tops and branching were good although there was a tendency to horizontal growth of the lower branches in all these mountain areas. Seed set was heavy at all of these places. At Monte Vista, Colorado, and Cheyenne, Wyoming (elevation 7,600 and 6,300 feet, respectively) there was a tendency for semi-vegetative development in the flower stalks and also failure of some plants to bolt. At Fort Lewis, Colorado (elevation 7,600 feet) growth of tops and set of seed on early branches was excellent, but on August 21 seeds had not started to ripen. It appeared that much of the seed would not ripen at these 3 high elevation stations. Curly top had been observed to be severe some years at Ft. Lewis. At Torrington, Wyoming, growth of beet was very poor, although limited trials there last year had been promising. Because of labor shortage, weeds had not been controlled well this year. It was observed in general that seed production of beet is much more severely affected by weeds and poor cultural conditions than carrot.

In Utah the beet trials at Richfield and at Glendale were promising although various factors prevented obtaining dependable yield records. No evidence of curly top of beet was noted, and it was reported that curly top has not been prevalent in Utah the last two years. So far as known, no sugar beet seed is being produced in these two areas.

From these limited trials it appears that, from the standpoint of soil and climate, table beet seed could be produced successfully on the eastern slopes of the Rockies at elevations of 5,000 feet or lower. It would seem that areas in Utah where curly top will permit and not being used for production of sugar beet seed could be utilized for table beet seed, but more dependable information will be available in another year.

Carrot

The trials with carrot were excellent at Grand Junction, Colo., and at Wheatland, Colo., and Torrington, Wyo. Results were somewhat less convincing at Olathe and Cortez, Colo., and at Worland, Wyo. The plot at Olathe, Colo., had been injured by hail, and unfavorable cultural conditions probably caused the poorer development at the other places. At Greeley, Colo., the set of seed was only moderately good and much seed was lost by attacks of grasshoppers. At Sheridan, Wyo., there had been injury by breaking of plants by high winds. At Fort Lewis, Colo., (elevation 7,600 feet) plant growth was excellent and seed set was remarkably good on the early heads, but development was so late that it seemed doubtful if a satisfactory yield could be expected in the short season there. At Monte Vista, Colo. and Cheyenne, Wyo., growth was only moderately good and ripening of seed would be late as a result of the short season.

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In Utah, only a modern to number of roots were available for spring planting, but the development of the plants and the set of seed promised very satisfactory yields at Logan, Farmington, and Richfield. Carrots overwintered in the seed row at Logan, Farmington, and Richfield suffered some winterkilling. Loss was severe with July seeding but with August seeding survival was sufficient to give a very satisfactory stand. Growth and branching was excellent at all three places and set of seed was very good. The number of branches per plant was less from the direct seeded plants than from the spaced spring set roots, but the seed yield per row appeared to be about the same. In southern Utah, at Parowan, and at Washington, direct seeded carrot had survived the winter well, but not all of the plants had sent up seed stalks. The plants that had bolted had made a very good growth with a good set of seeds.

It is apparent that, from the standpoint of soil and climate, carrot seed could be produced successfully in many areas in the Mountain States at elevations below 6,000 feet. Crop hazards, however, from hail in Colorado, and from wind in Wyoming, must be considered. It would seem feasible to grow carrot, seed to seed, in Utah, using a suitable seeding date, if that method of production should prove desirable.

Further reports on this work will be made from time to time as results are available.

CABBAGE SEED PRODUCTION IN CALIFORNIA AND OREGON 1944 (9)

Glenn S. Pound

Salinas & Santa Clara Valleys (California)
March 9, 10, 11

Some 600 acres were seen in these areas, comprising 31 fields and some 16 varieties. Most of the fields had matured marketable heads and had been cut over. Some were just being cut and some were yet to be cut. Those which had been cut over early (Dec. - Jan.) were, in general, well bolted and were either in early bloom or were 7-10 days short of bloom. These which had been only recently cut over were beginning to shoot side branches and will apparently form good seed stalks. Examination of uncut heads indicated that bolting would occur when heads were cut. Only 2 fields were seen in which the percentage of bolters might be doubtful according to the way other fields are doing. One (Red Rock) was transplanted too late for heads to form. This field will probably have about 50% bolters and 50% non-bolters. The other (P. W. Dutch) was uncut but the heads were fairly mature. It is thought that a good percentage of these plants will bolt but it is less certain than other fields. Although fields are in all stages from early bloom to uncut heads, it appears that the percentage of bolting will be very high in all varieties where mature heads have been produced. The prospects for a good seed crop in this area appear to be very good at this stage. It appears that this method of obtaining a crop of head cabbage and a crop of seed from the same plants can be maintained in this area under Normal Climatological Conditions. It would seem that the security of obtaining this double crop would be in getting the seed sown early enough for heads to mature before growth is stopped. Coulter says that Pearson estimated that about 40% of the California plantings formed marketable heads and about 40% was planted too late for marketable heads. The remainder was intermediate. Beebe (Woodruff Co.) estimated that about 20% of their acreage did not form marketable heads. Most of the plantings which did not form heads are apparently in the San Joaquin valley.

The common practice this season has been to sow seed directly instead of using transplants. The bulk of the plantings seems to have been in late July and August. Most growers prefer this type of culture. The majority of the plantings are in

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double rows on 40 inch beds. This is nearly twice as many plants per acre as is normally used in the Puget Sound area.

A few fields which were in early bloom were immediately adjacent to fields of blooming broccoli. The matter of isolation from other Brassica crops will be of importance in this area.

Infections of downy mildew were common but no damage was being done. Traces of Ring Spot and Alternaria were found in several fields but were of little importance. One or 2 fields were found in which Sclerotinia rot (evidently soil borne infection) occurred. Scattered infections of Cauliflower virus were found throughout the area and a few plants showing symptoms of turnip virus were found. In general, the disease picture was not at all exciting and fields were quite clean. The cabbage aphid was present in many fields and was beginning to effect damage in one. This may be a troublesome pest as the season advances.

San Joaquin Valley (California
March 14 - 17

Over 350 acres of cabbage being grown for seed were observed. This was scattered from the Sacramento delta area to Fresno. Small plantings occur around Bakersfield and the Sampoo area but time and transportation limitations did not warrant seeing them.

In the San Joaquin valley most of the plantings are in 36 - 42 inch rows. Some fields are in double rows as in the Salinas area. Most of the fields were from direct sowing but a good percentage were from transplants.

Very few fields were planted early enough to mature marketable heads before bolting. Consequently there will be very little "double-crop" fields. In general fields are not quite as far advanced as in the Salinas area and an accurate estimate of bolting is therefore more difficult. In general it appears as if the percentage of bolters will be very good and prospects for seed at this stage are good. Plantings are evidently not as far advanced as they were at this time last year and extremely hot weather in the blooming or early dough stage may

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be a potential yield-reducing factor. Indications are that it is more difficult to get plantings started in this area in July and August than it is in the Salinas area. Consequently, securing a crop of head cabbage before growth is stopped in the winter seems less certain for this area. Seemingly, late maturing varieties must be planted in July and August for heads to mature. There are also indications that insect pests may be more troublesome in this area than in the coastal area.

Very little disease was found in the valley. Downy mildew was scattered but was effecting no damage. Leaf spot diseases were either absent or occurred only in trace amounts. Viruses were scattered over the whole area but in negligible amounts. As was expected, cauliflower virus1 was conspicuously predominant over turnip virus1 at this time of the year. One field of interest was 33 acres of Danish Ballhead being grown for Paramount Seed Co. The seed were sown in July 1942 and the entire planting was transplanted to a new field in March 1943 due to proximity to another variety. Very little bolting occurred in the summer of 1943 and the plants were thus carried through to this season. They were well bolted and in early bloom. The virus build up in this field was markedly greater than in other fields, due, no doubt, to its exposure during two seasons.

Observations made on a plot of the Truck Crops Division of the Davis College of Agriculture showed that in that area seedings of late maturing varieties had to be made in July and early August to mature marketable heads. Seedings of several varieties made (sown in seed flats and transplanted after 60 days±) July 1, July 15, Aug. 1, matured heads. Later seedings did not mature heads and bolting will depend upon seeding date and the specific variety.

Although some 16 different varieties of cabbage were observed in the State of California no conspicuous difference in the bolting of the different varieties within a given area or between areas could be found at this stage of the crop. It appears that, in general, all varieties were planted early enough and had a cooling period sufficient to effect bolting. This point can be better clarified later in the season.

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The disease picture throughout the California areas was not all serious at this stage of the crop. It does not seem likely that any serious losses from diseases will occur.

The isolation of cabbage fields from broccoli and other members of the B. Oleracea group in the lower Salinas valley and in other sections where broccoli is grown will be an important consideration if quality seeds are to be produced in these areas. Several fields were seen in early bloom or approaching bloom beside or close by fields of blooming broccoli. Wet ground was given as the usual excuse for not having such broccoli fields destroyed. Seed from such fields will be of reduced quality unless such seed stalks already in bloom as well as the broccoli are removed before the remainder of the plants come into bloom.

Willamette Valley, Oregon
March 21 - 23

Over 175 acres of cabbage being grown for seed in the Willamette valley were inspected. This acreage was centered around Corvallis and Eugene. Some plantings of Racine Market around Eugene showed moderate winter injury. These fields were transplanted early enough to mature heads before winter. Other transplantings from the same plant bed were made late enough to go into the winter in a loose head or leaf stage and showed little winter injury. The percentage of bolting will be good in all plantings of this variety.

Around Eugene the J. A. Boyce Company has some 170 acres. Much of this acreage is planted in 8 foot rows with plants thinned to 12-18 inches in the row. One field of Copenhagen Market was very weak, the plants being small and moderately infected with mosaic. Plants for this field were grown in the Mount Vernon area and transported to Oregon for planting. A field of Stoins Flat Dutch looked very promising and showed only mild mosaic symptoms in spite of the fact that the plants were grown around Mount Vernon. This observation is in keeping with previous observations that this variety is quite tolerant to expression of Mosaic symptoms.

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Another field of interest was a 20 acre planting on the Wm. James farm. These plants showed a rather heavy infection of Mosaic. The plants were grown in a plant bed which was less than 20 rods from a 1943 seed field. This indicates that unless care is exercised in locating plant beds the virus problem may become important in this area.

A planting of Ballhead eight miles south of Portland was planted for head cabbage and the heads were harvested around February 1-15. The stumps had bolted excellently and the field would no doubt make a good crop of seed.

The percentage of bolters will be very large in all plantings observed. In an experimental planting of P. W. Miller's at the Oregon Experiment Station a planting of Wisconsin Ballhead sown June 14 and transplanted September 15 was bolting perfectly.

Except for virus infections already mentioned, the Oregon Plantings were quite free of disease. As was expected this season of the year, virus B was conspicuously predominant over virus A.

Cabbage is being grown for seed in the Grants' Pass, Roseburg, Coquille, and Legsden areas but these plantings were not observed.

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CABBAGE SURVEY - U. S. POUND

California and Oregon March 1944

Date	Variety	Acres	Contractor	Grower	Location	Remarks
			Salinas and Santa Clara Valleys			
9-11	Glory	30	Lupton	Grainger	Salinas	Hds.harv.Dec.;well bolted; near bloom
"	"	40	"	Stolich	Sprockles	3/4 cut over bolted;not acc. FSCC since not rogued;t not cut hds burst and bolting
"	"	15	Germaine	-	"	cut over; well bolted;rejected FSCC; off types
"	"	45	Woodruff	Holmes	"	Cut over;exc.bolting;early bloom stage
"	"	20	Pancinelli	-	Hollister	part cut and bolting;restuscut but will undoubtedly bolt
"	"	20	"	-	Gilroy	cut over in Dec.;well bolted; near bloom
"	"	20	"	-	Alviso	just cut over;bolting indicated
"	"	20	"	-	Milpitas	cut over early;exc.bolting; early bloom
"	"	6	"	-	"	part cut early;exc.bolting; late cut also bolting
"	Cop. Mkt.	10	Lupton	-	S.Gonsales	part cut over;mature heads burst and bolting
"	"	10	Woodruff	-	Castroville	cut in Dec.;exc.bolting;near bloom
"	"	16	F. M.	-	San Juan	cut early,well bolted,near bloom
"	Succession	16	"	-	Salinas	many bolting thru uscut hds; bolting well where hds were slit
"	"	12	Woodruff	-	San Juan	cut early;exc.bolting;early bloom
"	Oakview BH	12	F. M.	-	S.Gonsales	hds.small,slit,beginning tobolt
"	Dan BH	30	Woodruff	-	Salinas	not cut,hds.slit,will bolt OK; blooming broccoli adjacent
"	P.S. B.M	21	F. M.	Little	W.Greenfield	being cut-will probably bolt
"	"	10	Woodruff	-	Castroville	cut over - bolting O.K.
"	"	30	F. M.	F.M.	San Juan	Hds.slit, bolting good
"	Hollander	15	"	"	"	" " " "
"	M.S. Mkt.	12	"	Verti	N.Gonsales	being cut over;FM confident will bolt
"	Golden A	75	"	Aura	S.Greenfield	cut over;well bolted;exc. prosp; near bloom
"	F.Md.D	30	F.M.	-	King City	mat.hds cut and left in fld; bolting from stumps just beginning
"	Savoy	12	Woodruff	-	Castroville	Hds not cut or slit;many bolting;10% early bloom;broccoli nearby
"	M.R.Rock	5	"	-	"	tr.too late for hds;goodly % show buds,rest prob.will head
"	W.A.S.	26	"	-	"	Hds large soft,somecut,bolting probably will be good
"	F.Fl.D.	20	"	-	"	not.cut;hds soft;few bolted; many show bud differentiation

"	A. H. E.	6	"	-	Salinas	Some harv;good bolting but irregular
"	J.W.	10	FM	Bert	San Juan	6 A.cut;well bolted;early bloom 4A.not cut; hds bursting,bolting
"	O. Savoy	13	"	"	"	Hds slit,well bolted,early bloom
"	St.B.F.D.	30+	"	"	"	80% bolted; not seen
	Sacramento and San Joaquin Valleys					
14-17	Mar.Mkt.	30	Puccinelli		20 mi.N.E. of Stockton	plts.small irreg.largest just beginning to bolt
"	Cop. Mkt.	63	Paramount		13 mi.from Stockton in delta	Tr.late Nov.sm.bolting without forming heads - near bloom
"	"	100	Robinson		Firebaugh	Seeded thick 10/20-no heads early bolting-double rows
"	"	16	S. & Groot		"	Seeded double rows - too late for hds - early bolting
"	"	30	Paramount	LeBahja ranch	Modesto	Sown directly Sept.;irregular from hds to none; bolting
"	Glory	25	Puccinelli		E.Turlock	Tr.in Sept. 3 ft. rows no hds early bolting general
"	"	8	Robinson		Chowchilla	3 ft.rows no mature heads, early bolting
"	"	15	Royal		Firebaugh	ditto
"	M.S.Mkt.	16	Robinson		E.Turlock	sown direct in 42" rows some early enough for mature heads all just beginning to bolt
"	D.B.H.	33	Paramount		N.Dipon	seed sown Jul.42;entire fld moved Mar.43 - no bolting 43 field now com.bolted and in early bloom
"	"	20	?		Chowchilla	Seed sown dir.in 3 ft.rows 10/16/43-no mature heads-plants in good growth-bolting tendency just evident - prospects good
"	P.S.B.H.	25	Puccinelli		E.Turlock	Seed sown in place Sept.seed hard hds to no hds good % bolting beginning
	Willamette Valley - Oregon					
2-23	Ros.Mkt.	65	Smith		Corvallis	4-5 ft. rows-mostly transplanted early enog to winter as mature hds; mod.winter injury;bolting OK but plts weak;other flds trans trans.late enuf to winter as loose hds or no hds;very little winter injury;bolting O.K.
"	O.Savoy	10	Kelly		Albany	Seed sown July 5,trans.Aug.20, winter semi hard hds, com. b bolting,near bloom,very little winter injury
"	"	1	Boyce	Denham	Eugene	Seed sown July 5,trans.Oct. winter as soft to no hds,bolted well,near bloom
"	Glory	45	"	Strom	Jat.City	Seed sown July, tr.Sept. 15, winter soft hds, bolting com. near bloom
"	Steins	13	Boyce	-	Eugene	Tr.Sept.15 with Mt.Vernon,Wash. plts.-no hds formed but good growth - bolting well

"	Red Rock	1/2	Boyce		Eugene	Seed sown July 5, tr Aug., semi hard hds fall, exc. bolting near bloom
"	C.Mkt.	7	"		"	Transpl. Sept. 21 with Mt.V.Wash plants, ppor stand and growth bolting directly no heads
"	D.R.H.	40	"	James	"	20 A seed sown June 9 trans. late Nov. baseball hds produced bolting excellent - 20A transp after Feb. 20 with plts pulled and pitted in Dec. First of these bolting but weak
"	"	5	"	Coren	"	Seed sown July - trans Sept. 15 No hds but appears will bolt well
"	C.Acre	-	-	James	"	Trans only recently with plts from every seed bed, plts small and not bolting yet

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Report by J. C. Walker

April 5-7, 1943 Willamette Valley and Roseburg area, Oregon

Roseburg in the upper Umpqua valley is an old winter cauliflower growing area. That crop has reduced somewhat in recent years and for this season is about over. One field of cabbage which had been cut and allowed to go to seed (said to be contracted by Lilly) was in full bloom. Variety undetermined but appeared to be Ballhead type. This had bolted very well and should yield seed (6± acres). However it is adjacent to cauliflower most of which had been cut but some left uncut were about to open blossoms. No attempt was apparently being made to prevent crossing.

In the vicinity of Eugene (upper Willamette Valley) several cabbage seed fields were noted. All of these appeared to be contracted by J. A. Boyce Company. Three of the fields were Chieftain Savoy. They had been transplanted in November and were bolting well--all having come from seed bed planted by Mr. James and were each well-isolated but in the James Garden area some 10 or more acres of D. Ballhead were in one block on the James farm. Part (about half) were from plants set out in Nov. ± and had survived 2 floods--one in November and one in January. They were bolting and being in 40" rows were plenty in number in spite of perhaps 20% which did not survive. After the January flood plants remaining in the seed bed which, being on higher ground, survived the flood were set out in the other half of the field. These plants though smaller than the earlier transplanted ones were bolting well and were a perfect stand. This half of the field was as good or a better prospect than the older half.

Cabbage fields seen in the lower valley were from sowings of midwinter and were small vegetative plants which obviously would not bolt.

It is evident that cabbage seed may be grown in this valley. Floods of the river are a hazard and the warm temperatures in May and June may be unfavorable

to the maturing of the seed. Roseburg may also be a possibility with a slightly milder winter. However in all this area brassica cross contamination is a factor which must be watched. For surety of bolting, cabbage must be transplanted in O ober and November in order to assure bolting.

April 8-9-10. San Joaquin Valley, California. Following up leads already developed by Harold Coulter.

In the vicinity of Modesto, Turlock, and Merced a very large acreage of cabbage was planted in 1942 for dehydration plants in this area. Many of these fields were checked by the cold of mid-winter and at present are bolted and approaching full bloom. Some fields bolted without producing heads. This was particularly true of Copenhagen Market sown direct in September. These fields are usually thinned to 18-20" in the row and 42" to 48" rows. Some 175 to 200 acres of Copenhagen were observed which were uniformly the finest prospect for seed I have seen in many years. No disease was found. They may average 1000 lbs. per acre; some might go higher. A considerable acreage of Penn State Ballhead--much of which was cut for the drier--bolted from the stumps. This, a longer season variety, was sown somewhat earlier than the Copenhagen Market. There was a varying percentage of immature non bolting heads but nevertheless the prospects for seed were good. Some 100 acres were observed which might average 600 lbs. or more per acre. One field of Midseason Market (about 30 acres) was also in full bloom. A field (75 acres) of Danish Ballhead of recently transplanted bolting plants showed considerable promise. Another field (100 acres) containing 3 varieties not seen was said to be typical of those described.

It was very evident that in this area the winter had been cool enough to break dormancy in these varieties and that the prospects of a heavy seed crop

were good. This whole phenomenon was a surprise and new to everyone who contacted it. It is obvious that this area has great potentialities as a supplementary cabbage seed acreage and that further study of proper planting dates for optimum bolting of various varieties would be valuable. It appears that it may be possible to work out a schedule where a crop of heads may be marketed and a full crop of seed produced from the stumps

A field of Ferry's Non-bolting Flat Dutch was observed of which 15%± had bolted; the rest was apparently going to head. This variety is a selection for winter non-bolting derived from the Colma stocks long grown in the Bay region. Apparently easy-bolting segregates were going to seed. Some plants from the same field were transplanted in the Salinas valley. They were observed there a few days later, and were in the same condition--indicating that this variety has in reality a large percentage of non-bolters.

April 12-17. Santa Clara and Salinas Valleys

No fields were observed in the Santa Clara valley except small plantings at Associated Seed Growers trial grounds (Milpitas). It was of interest to note that a plot of Copenhagen Market was in full bloom while one of non-bolting Flat Dutch had about 15% bolters although the 2 lots were planted the same day. This conforms with observations on the latter variety noted above.

In the Salinas valley several fields of cauliflower including Snowball and Veitch's were visited. Most of these were still in the curd or recently starting to bolt. The growers (Ferry Morse) were confident from previous experience that a full bolting would follow.

A ranch having 175 acres of Stein's Flat Dutch near Castroville was showing 5 to 15% bolters but the remaining plants bid fair to head. A field

(9 acres) of Savoy near Consale's was in full bloom. Some heads had been cut. Many had bolted directly. There is every indication that cabbage seed can be grown successfully in this valley and indications were that several hundred acres would be contracted here for 1944. This valley has the advantage of cooler weather during seed maturation. Some ring spot (black blight) was noted but in no case did it appear to be serious. Isolation from other B. oleracea is a problem.

April 19. San Fernando Valley near Los Angeles.

Some 140 acres of cabbage had been planted here for seed. Varieties were Bugner, Wisconsin All Seasons, Red, Copenhagen, Savoy, Flat Dutch. Seeds sown in August 1942. Plants had headed well and had been opened by slicing. Some bolting had resulted. In general the good bolters were 5% or less. Some 10% were semi-vegetative bolters. In no case did any field seen give good prospect for a successful seed crop. Most plants gave the picture of having not had enough cool weather to become fully reproductive. Many which had bolted were still semi vegetative. It is my opinion that this is a very risky area for seed and I doubt very much whether it has enough cold to be safe.

At El Monte one field of Copenhagen (9 acres) had bolted very well without maturing heads. It was now in full bloom. This is the easiest bolting variety and it may be that El Monte was slightly cooler than San Fernando. Sclerotinia rot (white blight) was beginning on the lower stem of numerous plants and there is a possibility that this disease may take a toll before this crop is mature. Cauliflower was growing next to this field. This and several occasions noted in San Fernando area indicated that isolation from other members of B. oleracea was not being watched and practiced rigidly. In this area the problem of isolation is an important one.

April 20-22. Arizona

Salt River Valley. Cauliflower growing for seed in this area was advanced nearly a month over plantings at Salinas. Prospects were good for a crop. In one field about 10% loss from Sclerotinia was evident.

Cabbage plantings (T. Madsen) were in many fields in this area. Varieties were Golden Acre, Copenhagen Market, Ballhead, Glory. Culture was good. Plantings were later than last year - November. Generally these fields are headed and bolters are rare even though heads were sliced some weeks ago. The Danish Ballhead had best bolting. It was on very fertile soil. About 20% bolters but many still semi vegetative. Thrips are very severe in flowers and yield will be practically nil. Griffiths reports that in 1941 early plantings were made and a much better percentage of bolting occurred in 1942 although the crop was lost because of insects. Experimental plantings at Tempe station were made at dates comparable to the 1941 commercial plantings and bolting was better. However there is little evidence as yet that cabbage seeding can be relied upon here.

At Tucson in Prof. Finch's garden seeding August 3 and transplanting September 15 with Jersey Wakefield (and Marion Market replants) yielded heads around December 1 harvesting continuing through February. Bolting from stumps now fair but seed plants are still partly vegetative and some highly so. This area has about 1400 hours of chilling at 45° F. or below. The Salt River valley gets about 800 hours. Some plants transplanted October 25 and shaded partially made semivegetative seed plants while adjoining row not shaded made heads. A field near Tucson of commercial scale for Cornelli had 1800 hrs chilling -- Copenhagen or Golden Acre, sown late September, transplanted in December. Headed very small with no bolting.

At Douglas Danish Ballhead in 2½' rows at 2' in the row bolted about 50% from stumps of heads cut in November. However many heads remained dormant and many bolters were semi vegetative. The abnormal development of many flowers suggested possible infection by beet curly top which was very severe on garden beets. Safford Valley - Thatcher - garden planting of Marion Market and Jersey Wakefield. 90% of the MM were bolting but semivegetative; 10% of the Jersey Wakefield.

Duncan Valley - A field (now plowed up) of Charleston Wakefield sown July 15 had bolted well from stumps. Golden Acre never planted in summer-fall here since it sunburns badly.

There is little evidence that Salt River Valley can be relied upon for cabbage seed production. In the somewhat higher valleys possibility holds with some varieties if proper planting dates are worked out. It would appear that mid summer sowings designed to mature heads for market about Nov. 15 have a possibility of bolting to seed. This is still definitely in the experimental stage however but of course can be risked commercially since the harvest of heads for market greatly reduces the financial risk. The possibility of curly top as a seed plant disease of importance should be watched.

large acreages. They, therefore, contract usually with such houses as least particular about their stocks, since they are in volume production and selling to the least particular trade and are, in a sense, quantity producers and price cutters rather than quality producers of well bred stocks. When one traces the stock from which most of these fields are planted, he finds that there is no stock breeding behind it; it is merely the increase of trade seed over and over. This is not entirely true, but it is very much the case. You will find reputable houses having acreages in this area, but they are being produced for the type of demand that is outlined above.

I point out this situation for what it is worth to those who may read this report. It is, I think, safe to say that the best seed-growing soil in Wright County is now and has been for a long time [illegible] that more acreage cannot be handled wisely without some type of regulation and concentration of a given variety within a given portion of the area. This has been realized by seed contractors for a long time, and it is [illegible] one seldom finds yellows resistant varieties or other choice stocks being increased in the Humboldt region. When a yellows resistant variety reaches a high volume level as Marida Pinto now is, one finds in this area, as is the case in 1942, several large fields, but they have been in the case of those that I have judiciously grouped among themselves and properly isolated. This became possible because a local grower had control of these lots and was able to get adjacent farmers to handle a considerable acreage.

The La Conner flat area is below high-tide level. It is protected by dikes along the sea and the river channels are protected by levies. It is subject to destructive floods during the winter months if there is a break in the river levy at high water. In earlier years winter flood damage was common. I recall that in the winter of 1918 — 1919 this whole area was flooded and practically all cabbage seed in this choice area was completely lost. Flood damage has occurred from time to time since. While I have not followed it in detail, my impression

cabbage mosaic viruses of the mid-west occur there generally but from my observations in 1940 and again in 1942, I do not regard them as more than incidental so far as crop production is concerned. These virus diseases are conditioned very much by prevailing temperature. Contrary to the situation in the mid-west, the Puget Sound environment seems to relegate them to a minor position.

White blight is the same as that prevalent in the South as drop or watery soft rot of cabbage. It sometimes is destructive on the crop in the Puget Sound area in the late fall and winter, but the white blight phase is that which results from the discharge of ascospores in the spring and the infection of the seed stalks primarily at the bases of the leaves or thru infected leaves. The main stalk thus becomes parasitized and gradually weakened preventing normal maturity and size of seed or lodging even to breaking over the stalk. It is evident that the Copenhagen variety and strains of it show more of the white blight than other varieties. It remains to be determined whether this is a true resistance or whether the characteristic cup-shape of the leaves of this type of cabbage facilitate infection at the leaf base more effectively than that of other varieties. Apparently this disease is as prevalent in 1942 as it ever has been observed before. I am inclined, however, to tone down rather the emphasis to over all destructiveness. I would certainly rate it second to ring spot.

Ring spot is not as prevalent nor as destructive in 1942 as it has been in 1940 and 1941. Dr. Huber of the Puyallup Station seems to be of the opinion that it will still cause heavy losses. It should be borne in mind that he has not studied the situation critically in 1940 and 1941 and by his own statement began his investigations in the fall of 1941. By comparison I am forced to regard the disease as relatively light this year as compared with the two previous years. If unusual rains come in July, it is possible for extensive spread from lesions on the leaves to the pods resulting in shrinkage, light seed and general reduction

in yield. However, from what I know of the weather this possibility is extremely remote.

There is apparent this year wider differences in varietal reaction to ring spot than have been noted there previously. Copenhagen Market and its strains such as Marion Market are practically free from ring spot this year. Since Copenhagen Market occupies such a large percentage of the total acreage, this reduces much the danger of crop losses from ring spot this year. I did not notice in 1940 this apparent absence of ring spot on Copenhagen and Marion Market. My supposition is that, as is often the case when a mild epidemic is compared with a severe epidemic of a given pathogen disease, the differences in varietal tolerance appear and tend to become quite striking which are otherwise not apparent. I believe that is the case here. It certainly should not be said on the basis of evidence to date that the Copenhagen types are highly resistant. It may be entirely a situation in which the Copenhagen types released their infested lower leaves during a given stretch of winter weather so that they were blown away and further infection prevented. In any case we have what has been commonly observed--that the Ballhead and Ballhead-like types are the more generally infected this year. All Seasons is nearly in the same class. These varieties are lower in volume but much higher in value than Charleston Wakefield and Copenhagen Market. Large acreages in the northern states are entirely dependent upon them.

The preliminary dusting and spraying experiments which I saw in 1940 at [illegible] and those which Dr. Huber has at La Conner in 1942 strongly indicate that control of ring spot is not to be found in fungicidal attack. It is believed, however, that attention to sanitation during the first year's growth of the crop and during the succeeding winter may go a long way to avoiding heavy losses from this disease. Dr. Huber has shown recently that the organism is seed borne, although this was strongly indicated by Weimer's work earlier. It should be

emphasized that ring spot has never been authoritatively collected on growing crops East of the Rocky Mountains and there is every reason to believe that such will continue to be the case. The fact that the ring spot organism is now definitely known to be seed-borne is no cause for alarm to mid-West and Eastern growers and in my estimation should not be talked up. I assumed for years that ring spot was coming into this part of the country on seed but something about the environment East of the Rocky Mountains checked it. Quite the same is true of black leg and black rot in the Puget Sound growing area. However, in the Puget Sound area it seems to be important to have ringspot clean seed in the seed bed. This is being emphasized locally and should be encouraged. This hardly applies to Eastern grown stock seed which is brought in annually by those seed contractors who are really carrying on a breeding program. However, the cheaper producers are using Puget Sound seed over and over and in that way the fungus is introduced into the seed bed. Personally, I am not quite ready to accept Dr. Huber's emphasis on this phase since by his own admission the disease does not develop in the seed bed but generally after transplanting. However, it is a measure which in any case should be good insurance. The serious development of ring spot comes after transplanting when the September rains come and ascospores are being discharged generally from mature seed fields of the previous year. The picture that I get, although I have never been there in the late fall, is that ring spot is quite general on the lower leaves of the cabbage plant. Thus, there is a general inoculum ready to carry over for spring infection on the vital seed stalks and seed pods. Dr. Huber emphasizes removal of the old head leaves and disposal as rapidly as possible in the spring, planting of the crop so as to provide best aeration in the fields, and tying up of the seed stems properly. Undoubtedly, all of these are good measures and, in my estimation, the only hopeful ones to keep ring spot in abeyance until the dry weather ensues in late May or early June. Ordinarily, the difference between a good seed crop or one reduced seriously by ring spot depends upon when the rains stop.

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A few days difference make a tremendous difference. The handling of the crop from transplanting on, including the time and amount of winter cover, removal of cover in the spring, removal of old, dead leaves, spacing of plants in the row, spacing between rows, and tying up of seed plants, ~~all here~~ has a direct bearing on the amount and the destructiveness of ring spot.

This leaves me to emphasize what I am sure was apparent to Dr. Toole, i.e., the general lack of good cultural practice based on scientific experimentation. This whole seed crop seems to me to be handled too much on rule of thumb method. Each grower or seed grower has a different thumb or rule. This is evident in the fair percentage of fields each year that go to head rather than to seed. We know enough about the physiology of the cabbage plant to understand, in a general way, why this occurs; but there is absolutely no local experimental information as to when the various varieties should be sowed, planted, rogued and covered; how much cover is necessary, when it should be removed in the spring, what is the relation of soil fertility to proper maturity in the fall. Thus, we have a host of horticultural and soil problems in which it seems to me have not ever been scratched. Nevertheless, we face the situation in which all of our cabbage seed is in this one basket. The losses and uncertainties over the years are tremendous. I know of no seed crop in which future crop estimates ~~are so near by~~ is so much like making trying to predict the weather in the Middle West 48 hours in advance. When you trace this down, it comes primarily from two things. One of these is the rule of thumb method in handling the crop. The other is that handling the crop has such a vital effect upon ring spot severely when weather conditions approach the optimum. I do not wish to make this appear as a matter of passing the buck, but I think it is only fair to call a spade a spade at a time like this year. I think we should know more about the horticulture of ~~growing~~ seed in the ~~middle~~ North West and that we cannot do much about controlling diseases ~~in the middle West~~ there when the obvious development survival is so dependent on good horticultural practice.

Abstracts and condensations from Memorandum of Dr. J. C. Walker on inspection of the cabbage seed crop in Puget Sound Area, June 3-5, 1942.

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"The cabbage seed growing area in Skagit County, Washington, developed first in the tide-water flats at the mouth of the river centering around the village of La Conner. Within a radius of 5 to 8 miles from this point the largest crops of cabbage seed are still produced. The situation this year is well illustrative of that, since in this immediate area, generally speaking, as good crops are in prospect as I have ever seen in my numerous trips to this area beginning first in 1919.

"As the need for more cabbage seed production grew and as the requirement for greater isolation of fields became stressed, the acreage expanded beyond this small and highly productive region onto higher land which, being more heavily eroded, was less uniform in texture and as a rule lighter in texture. These soils have never produced as heavy crops as the flat lands. However, in most cases the more desirable and highly bred stocks have been forced into such less desirable regions in order to get isolation."

The older, more skillful growers are located in the La Conner flats. They are interested in large yields and large acreages and tend to grow for firms that are less particular about adequate isolation. Instances were observed this year of varieties of different types having insufficient isolation. The best soils of the region are now so completely used that more acreage cannot be used safely without regulation of isolation and grouping of varieties.

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"As to the disease situation. It should be borne in mind that the dry summers in this area have over the years shown without much question that the two serious seed-borne pathogenes--those of blackleg and black rot--are completely checked and seed produced in this area is safely free from them. This has had something to do with the concentration of the crop in this area, although I doubt that it is the major factor in that trend. In the exploring of new areas along the Pacific Coast or elsewhere, this should certainly be kept in mind. In the mid-West and in the East where cabbage seed is grown in small amounts, it is never safely free from these two hazards. To be sure cabbage seed produced in semi-humid regions can be treated with hot water. Our experience, however, is that in spite of this available treatment it is often disregarded and terrific losses commonly occur. It is to be hoped that the production of disease-free seed will not be disturbed in the future expansion of cabbage seed growing.

"The two diseases that are mot troublesome in the Puget Sound seed-growing area are ring spot, known locally as black blight, and the Sclerotina disease, known locally as white blight. The two common cabbage mosaic viruses of the mid-west occur there generally but from my observations in 1940 and again in 1942, I do not regard them as more than incidental so far as crop production is concerned. These virus diseases are conditioned very much by prevailing temperature. Contrary to the situation in the mid-West, the Puget Sound environment seems to relegate them to a minor position.

"White blight is the same as that prevalent in the South as drop or watery soft rot of cabbage. It sometimes is destructive on the crop in the Puget Sound area in the late fall and winter, but the white blight phase is that which results from the discharge of ascospores in the spring and the infection of the seed stalks primarily at the bases of the leaves or thru infected leaves. The main stalk thus becomes parasitized and gradually

weakened preventing normal maturity and size of seed or leading to breaking of the stalk. It is evident that the Copenhagen variety and strains of it show more of the white blight than other varieties. It remains to be determined whether this is a true resistance or whether the characteristic cup-shape of the leaves of this type of cabbage facilitate infection at the leaf base more effectively than that of other varieties. Apparently this disease is as prevalent in 1942 as it ever has been observed before. In June I was inclined, however, to mark down rather than emphasize its over all destructiveness and rate it second to r ing spot. However, on October 1, 1942 I talked with a seedsman who had returned from supervising harvest of a considerable acreage. He reported that during the last month of growth the 1942 crop was very seriously damaged and the harvest reduced 20% or more by the inroads of white blight. This was due to a distinctive general aerial infection through dispersal of ascospores while conditions of infection were favorable leading to a large percentage of shrivelled worthless seed."

Ring spot is not as prevalent nor as destructive up to the present time this year as in 1940 and 1941. This year there is a wider varietal difference in ring spot than previously noted. Copenhagen Market and its strains such as Marion Market are practically free up to the present time this year. However these varieties should not be considered highly resistant. It is not unusual that varietal tolerances are more evident in a mild than in a severe epidemic.

"The preliminary dusting and spraying experiments which I saw in 1940 at Montesano and those which Dr. Huber has at La Conner in 1942 strongly indicate that control of ring rot is not to be found in fungicidal attack. It is becoming more evident, however, that attention to sanitation during the first

year's growth of the crop and during the succeeding winter may go a long way toward remedying heavy losses from this disease. Dr. Huber has shown recently that the organism is seed borne, although this was strongly indicated by Weimer's work earlier. It should be emphasized that ring spot has never been authoritatively collected in growing crops east of the Rocky Mountains and there is every reason to believe that such will continue to be the case. The fact that the ring spot organism is now definitely known to be seed-borne is no cause for alarm to mid-West and Eastern growers and in my estimation should not be talked up. * * * * However in the Pugen Sound area it seems to be important to have ring spot-clean seed in the seed bed. This is being emphasized locally and should be encouraged. This hardly applies to Eastern grown stock seed which is brought in annually by those seed contractors who are really carrying on a breeding program. However, the cheaper producers are using Puget Sound seed over and over and in that way the fungus is introduced into the seed bed. * * * * The serious development of ring spot comes after transplanting when the September rains come and ascospores are being discharged generally from mature seed fields of the previous year. The picture that I get, although I have never been there in the late fall, is that ring spot is quite general on the lower leaves of the young cabbage plant. Thus, there is a general inoculum ready to carry over for the spring infection on the vital seed stalks and seed pods. Dr. Huber emphasizes removal of the old head leaves and disposal as rapidly as possible in the spring, planting of the crop so as to provide best aeration in the fields, and tying up of the seed stems properly. Undoubtedly, all of these are good measures and, in my estimation, the only hopeful ones to keep ring spot in

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abeyance until the dry weather ensues in late May or early June. Ordinarily the difference between a good seed crop or one reduced seriously by ring spot depends upon when the rains stop. A few days difference make a tremendous difference. The handling of the crop from transplanting on, including the time and amount of winter cover, removal of cover in the spring, removal of old, dead leaves, spacing of plants in the row, spacing between rows, and tying up of seed plants, has a direct bearing on the amount and the destructiveness of ring spot.

"This leaves me to emphasize what I am sure was apparent to Dr. Toole, i. e., the general lack of good cultural practice based on scientific experimentation. This whole seed crop seems to me to be handled too much on rule of thumb method. Each contractor or seed grower has a different thumb or rule. This is evident in the fair percentage of fields each year that go to head rather than to seed. We know enough about the physiology of the cabbage plant to understand, in a general way, why this occurs; but there is absolutely no local experimental information as to when the various varieties should be sown, planted, rogued and covered; how much cover is necessary, when it should be removed in the spring, what is the relation of soil fertility to proper maturity in the fall. Thus, we have a host of horticultural and soil problems which it seems to me have not ever been scratched. Nevertheless, we face the situation in which all of our cabbage seed is in this one basket. The losses and uncertainties over the years are tremendous. I know of no seed crop in which making future crop estimates is so much like trying to predict the weather in the Middle West 48 hours in advance. When you trace this down, it comes primarily from two things. One of these is the rule of thumb method in handling the crop. The other is that handling the crop has such a vital effect upon ring spot severity when weather conditions

approach the optimum. I do not wish to make this appear as a matter of passing the buck, but I think it is only fair to call a spade a spade at a time like this. I think we should know more about the horticulture of growing seed in the Northwest and that we cannot do much about controlling diseases there when their development is so dependent on good horticultural practice."

"The actual yield of the 1942 of cabbage seed in this area is, I am informed by one seedsman, much lower than that of very conservative estimates in June. This was attributed to the unexpected late-season severity of white blight."

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THE PRODUCTION OF VEGETABLE AND HERB SEEDS IN ARIZONA (1)

3rd Ann. Report. May 1944

by

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THE PROBLEM

Prior to 1940 a considerable portion of the vegetable seeds used in the United States were imported. In the past few years these imports have been greatly reduced, and requirements of most kinds for planting here have increased. In addition to supplying the seeds used in this country, the United States is now committed to supplying many kinds of seed to the United Nations under the lend-lease arrangement. From a seed-importing country, the United States has become a seed-exporting nation in a few years time.

Broad trials to locate new areas for vegetable seed production have been undertaken by the U. S. Department of Agriculture in cooperation with various State Experiment Stations. The trials reported herein are the results of cooperative effort by the Arizona Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering.

HISTORY OF TRIALS

Preliminary trials of vegetable seed production in Arizona were made in 1939. Between 1940 and 1943 the seeding habits of some thirty types of vegetables and related plants have been studied. Investigations have been centered in the Salt River Valley but have covered ten localities from elevations of 100 to 4000 feet. It is evident that the climatic requirements for seed production of the different vegetables vary widely. This is especially true in so far as winter temperatures or chilling is concerned. Therefore, some kinds of vegetables which seed will at one elevation may be unproductive at another.

1942-43 TRIALS

Data obtained in 1942-43 for each district are shown below. Interpretations are made in the light of all evidence gathered to date from experimental and from commercial experience.

Yuma Valley - (Elevation 140 ft., 800 hours of chilling[2])

Lettuce appears to be the best adapted of the vegetables for seed production. More than 50,000 pounds were produced in 1942-43. A crop planted at the usual time for head production of a given strain can, by careful harvesting, cut a crop of heads and still produce a crop of seed from the stumps. Yields on the Yuma Valley Experimental Farm have been from 200 to 400 pounds per acre.

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(1) The work described herein on vegetable seeds was done in cooperation with the Division of Fruit and Vegetable Crops and Diseases, and that on Herb seeds with the Division of Drug and Related plants, both of the Bureau of Plant Industry, Soils and Agricultural Engineering in the United States Department of Agriculture.

(2) Chilling as used herein has reference to the number of hours during the winter when temperatures reach 45° or less.

Endive. This is an annual which seeds readily. 200-300 pounds per acre have been harvested in commercial fields.

Cantaloupe seed of excellent quality has been produced experimentally for several years. In 1943, a yield of 350 pounds per acre was obtained. Prompt harvest of the seed to prevent sprouting within the melons is necessary.

Onions. Utah Sweet Spanish onions were planted September 21 and October 8, 1942. These grew and remained vegetative. No seed stalks were produced. It is apparent that only onion varieties requiring a minimum of chilling can be grown on a seed to seed basis.

Carrots. Imperator and Chantenay carrots planted September 21 and October 8, 1942, bolted irregularly. Some carrot seed has been produced commercially, but bolting generally has been more irregular than in less warm areas.

Turnips. Purple Top White Globe turnips planted September 21 and October 8, 1942, produced seed stalks in March. Aphis were serious and caused the loss of the plants before seed could mature.

Beets. Detroit Dark Red beets were planted September 21 and October 8, 1942. Bolting was irregular and seeding very light. Beets appear to require more chilling than occurs at Yuma.

Salt River Valley
(Elevation 1,100 feet - 1,100 hours of chilling)

Studies on vegetable seed production have centered at the Salt River Valley Vegetable Research Farm. All experience to date indicates that the crops best suited for seed production in this area are: broccoli, red beets, carrots, lettuce, onions, cantaloupes, and cauliflower.

Beets. Data for the 1941-42 and 1942-43 experiments are shown in Table 1.

Table I

DATA ON TABLE BEET SEED PRODUCTION
1941-42, 1942-43
Salt River Valley

Variety	Year	Date Planted	Date of Market Maturity	Date of Full Bloom	Date of Seed Harvest	Yield Lbs. per acre 41-42	Yield Lbs. per acre 42-43	Average Germination
Crosby Egyptian	1941-42	10/12/41	1/1/42		6/20/42	3374		
	1942-43	9/25/42	12/10/42	4/1/43	6/4/43		3092	80%
Early Wonder	1941-42	10/12/41	1/1/42		6/20/42	2843		
	1942-43	9/25/42	12/10/42	4/1/43	6/4/43		2976	82%
Detroit Dark Red	1941-42	10/12/41	1/15/42		6/20/42	2233		
	1942-43	9/25/42	12/20/42	4/9/43	6/4/43		1809	75%
Landreth Best	1942-43	9/25/42	12/15/42	4/5/43	6/4/43		1652	86%
Ohio Canner	1942-43	9/25/42	12/20/42	4/9/43	6/4/43		836	75%

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It is evident that table beet seed can be grown satisfactorily on a "seed to seed" basis. No comparisons have been made between yields from "seed to seed" and "seed to root to seed" methods.

In both 1941-42 and 1942-43 two replicated plots of 1/100 acre were planted to each variety. A standard 40-inch bed with two rows 16 inches apart was used. The crop was irrigated up on October 12 in 1941 and September 25 in 1942. Seedlings were spaced 4-6 inches apart. Ammonium phosphate fertilizer was applied under the seed at planting and further nitrogen and phosphorus side dressing given as needed during the growth of the crop. Irrigations were applied as needed to keep the soil moist, especial care being used to keep the soil damp during the period of seed stalk formation, flowering, and seeding.

It was found that the earliest maturing seed was of considerably better quality than that maturing later. Efforts should be made to mature seed as early as possible. If further studies reveal that the "seed to root to seed" method delays seed harvest, there would be a question as to the suitability of the Salt River Valley for seed production of this crop.

When the variety and strain of beet is known to be pure, little deterioration in trueness of type will result from a single season's increase by the "seed to seed" method. However, it is safest and most desirable to dig the roots and replant only the best.

Curly top is present throughout Arizona but has not caused appreciable damage where the crop is planted early in September in the Salt River Valley.

Red beets cross readily with mangels, sugar beets, and chard. Growing these crops in the same area can damage both. Red beet production should not be undertaken in the Salt River Valley as long as sugar beet seed is being produced.

Italian Green Sprouting Broccoli. Data for the 1941-42 and 1942-43 experiments are shown in Table 2.

Table 2

DATA ON ITALIAN GREEN SPROUTING BROCCOLI
1941-1942, 1942-1943
Salt River Valley

Variety	Method* of Planting	Year	Date Planted	Date of Market Maturity	Date of full Bloom	Date of seed Harvest	Yield Pounds per acre	Acreage Germination
Early Green Calabreese	Seeded	1941-42	10/12/41	1/15/42	____	5/22/42	551	
		1942-43	9/25/42	1/11/43	2/15/43	5/5/43	1675	99%
	Trans-planted	1941-42	11/15/41	1/20/42	____	5/22/42	919	
		1942-43	10/16/42	1/15/43	2/20/43	5/5/43	1177	100%
Italian Green Sprouting-Early	Seeded	1941-42	10/12/41	1/15/42	____	5/22/42	553	
		1942-43	9/25/42	1/11/43	2/10/43	5/5/43	1989	98%
	Trans-planted	1941-42	11/15/41	1/20/42	____	5/22/42	478	
		1942-43	10/16/42	1/14/43	2/20/43	5/5/43	1920	96%
Italian Green Sprouting Intermediate	Seeded	1941-42	10/12/41	1/23/42	____	5/22/42	404	
		1942-43	9/25/42	1/25/43	2/25/43	5/5/43	1099	97%
	Trans-planted	1941-42	11/15/41	1/25/42	____	5/22/42	753	
		1942-43	10/16/42	1/29/43	3/1/43	5/5/43	1070	95%

* All seed was planted in the field on the dates indicated. "Transplanted" plants were taken from the seeded rows and planted in adjoining beds on dates indicated under "transplanted".

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It is evident that broccoli seeds satisfactorily. Broccoli seed has been produced commercially for five years with yields running as high as 900 pounds per acre.

Planting and care of the crop is similar to that described above for beets. Transplanting of young plants has caused less reduction in yield of broccoli seed than for cabbage or cauliflower. Broccoli flowers very early in the spring and is thus subject to damage from late frosts. This accounted for the reduced crop of 1941-42.

Broccoli seed, as well as the seed of most other cruciferous crops, shatters if allowed to dry in the field. Harvesting must be done promptly when the seed has turned brown, but before the pods are dry. Drying is finished on a floor in the shade.

Aphis are always a menace in production of broccoli for either the fresh market or seed. Thrips are suspected of causing damage to the flowers. False chinch bugs have caused damage in occasional years.

Carrots. Data for the 1942-43 studies are shown in Table 3.

Table 3

DATA ON CARROT SEED PRODUCTION
Salt River Valley, 1942-1943

Variety	Date Planted	Date of Market Maturity	Date of Full Bloom	Date of Seed Harvest	Yield Pounds per Acre	Average Germination
Imperator	9/25/42	1/1/43	6/1/43	7/25/43	1515	90%
Nantes	9/25/42	1/10/43	6/5/43	8/1/43	1104	94%

In the experimental plots seed was sown in two rows, 16 inches apart on a 40-inch bed. Culture and handling were essentially the same as for beets. There were two replications of 1/100 acre plots of both varieties. These varieties were grown commercially for seed in 1942-43 in both the Yuma and Salt River Valleys. Imperator has been seeded in the Phoenix area for several years. The experimental yields are probably somewhat higher than average. Commercial yields of 600-800 lbs. per acre should be possible.

The carrot requires approximately ten months to produce seed when grown as an overwintering crop at the lower elevations. Seeding prior to September 1 does not appear to hasten the production of seed materially. However, planting should be made before October 1, so the root can be well grown before growth ceases with cool weather. This seems to give stronger bolting in the spring with consequent larger flowers.

Bolting occurs in April with seed ready for harvest in July. Primary flower heads are ready for threshing several weeks ahead of the secondary heads. The seed does not shatter easily, so the entire crop can be ripened in the field and harvested with a combine.

Little is known of the chilling requirements of carrots, but they obviously have a low requirement in this regard. It appears to be reasonably well satisfied at Yuma and completely so in the Salt River Valley. In higher elevations plantings made in February have been observed to produce seed in July, but the flower heads were small.

Like beets, carrots should be dug, the rogues or "off types" discarded, and only better types replanted. "Seed to seed" production is easier and is probably satisfactory for one year's increase from a very pure strain. In the "seed to seed" method, the standard planting rate for market carrots is used and no thinning is done. When transplanted, carrots are reset to a 4-6 inch space. Loss of stand in transplanting has been serious on some soils, especially where Sclerotinia is present. Keeping soil somewhat dry aids in reducing mortality.

Cauliflower. Data for the 1942-43 studies are shown in Table 4.

Table 4

DATA ON CAULIFLOWER SEED PRODUCTION
Salt River Valley, 1942-43

Variety	Date Planted	Date of Market Maturity	Date of Full Bloom	Date of Seed Harvest	Yield Pounds Per Acre	Average Germination
Earliest Snowball	9/25/42	1/25/43	2/25/43	5/19/43	262	85%
Super Snowball	9/25/42	2/5/43	3/1/43	5/28/43	167	90%
Mission Special	9/25/42	2/20/43	3/25/43	6/4/43	62	85%
November-December	9/25/42	2/15/43	3/8/43	5/28/43	608	90%

The plantings were made September 25 in replicated 1/100 acre plots. Field culture was the same as for broccoli. One plot of each variety was transplanted. This retarded growth and no seed was produced by the transplants. As is well known, cauliflower does not stand transplanting nearly as well as broccoli. Cauliflower is much more sensitive to temperatures and soil fertility than are most of the cruciferous crops. Thus, seed production requires more careful handling. However, it has been produced commercially in the Salt River Valley for several years. The yield of 262 pounds per acre of Early Snowball is probably better than average for commercial production. A yield of 260 pounds was obtained in 1941.

Like broccoli, cauliflower requires little if any chilling for the production of seed. With the first warm weather in the spring bolting and flowering occur. Late spring frosts have damaged the flowers. This caused a complete loss in the experimental plantings in 1942.

The insect pests of broccoli also menace cauliflower.

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Onions. Data on the 1942-43 onion seed production trials are shown in Table 5.

Table 5

DATA ON ONION SEED PRODUCTION
Salt River Valley, 1942-43

Variety	Date Planted	Date of Market Maturity	Date of Full Bloom	Date of Seed Harvest	Yield Pounds Per Acre	Average Germination
Crystal Wax	9/25/42	4/25/43	5/15/43	7/15/43	215	93%
Utah Sweet Spanish	9/25/42	4/25/43	5/15/43	7/15/43	125	83%
Colonial Early White	9/25/42	5/1/43	5/20/43	7/15/43	90	70%
Red Creole	9/25/42	5/1/43	5/20/43	7/15/43	60	89%
Southport White Globe	9/25/42	6/30/43	____	____	0	—

All varieties were planted in replicate 1/100 acre plots using a standard 40-inch bed with two rows spaced 16 inches apart.

The Bermuda (Crystal Wax) and Sweet Spanish types of onion are standard varieties in the Southwest. Salt River Valley winter temperatures provide sufficient chilling to cause these varieties to bolt when grown on a "seed to seed" basis. Lower than usual seed yields of these varieties this year are attributed to the late planting. When onions are to be grown on a "seed to seed" basis, an early planting must be made to allow time for the growth of the bulb. A small bulb does not have the food reserves necessary to produce a large flower. Late planting also tends to give a later harvest, so that seeds mature during the hot weather. This may cause light seed.

This is the first year that the two southern hot bulb types, Colonial Early White, Red Creole, and the Southport White Globe have been tried. Seed production was not satisfactory from them.

Commercial yields of seed in the Salt River Valley in 1942-43 were as high as 400 pounds. The best results were from small bulbs or sets grown from December to July of the previous year and set in the field in November. Seed from those sets was harvested in late June.

Like beets and carrots, onion seed may be produced by either the "seed to seed" or the "seed to bulb to seed" method. Since the bulbs are at the surface of the ground, some roguing can be done without removal and resetting. Selections for stock seed, however, cannot be satisfactorily made. Stock seeds should be produced from bulbs rigidly selected.

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The present indications are that while onion seed can be produced in the Salt River Valley, elevations somewhat higher and cooler may be better suited. The greater winter chilling seems to give a stronger and more uniform bolting and the cooler temperatures during seed maturity result in fewer shriveled seed.

The major pest of onions is thrips. The damage caused is difficult to evaluate, but it is believed that these insects reduce the vigor of the plant and cause some of the blasting of blossoms commonly observed. There is no completely satisfactory control; spraying or dusting with nicotine or pyrethrin is of some help.

Irrigation plays an important role in onion seed production. Due to the small root area onions suffer from lack of water sooner than many crops. It is necessary to maintain a good soil moisture level at all times and especially so during the spring and early summer when seed are filling and maturing. In many instances, "blighted" seed heads have been observed to accompany deficiency of soil moisture.

Minor Vegetables. Table 6 presents the data on seed production of these crops in 1942-43.

Table 6

DATA ON MISCELLANEOUS VEGETABLES
1942-1943
Salt River Valley

Kind	Variety	Date Planted	Date of Market Maturity	Date of Full Blossom	Date of Seed Harvest	Yield Pounds Per Acre	Average Germination
Rutabaga	American Purple Top	9/25/42	1/15/43	3/15/43	5/28/43	369*	95%
Turnip	Purple Top White Globe	9/25/42	11/25/42	2/15/43	5/19/43	63*	50%
Collards	Georgia	9/25/42	11/30/42	3/5/43	5/19/43	3198	60%
Mustard	Southern Curled	9/25/42	11/30/42	3/1/43	5/10/43	75	35%

*Rutabaga and Turnip yielded 239 lbs. and 70 lbs. respectively during 1941-1942.

These crops were all planted in replicate on 1/100 acre plots in the manner described for preceding crops.

Turnips planted in September are in full bloom by February and are thus subject to injury from frost. A planting made in November or December to give a later blossoming should increase the yield of this crop.

Rutabagas reach market maturity approximately six weeks after turnips and bloom profusely one month later. Seed yields have been considerably greater.

Collard is a cabbage-like, leafy vegetable. The demand for seed is limited. However, the large yields obtainable in the Salt River Valley warrant

its consideration as a minor seed crop. Collards require little attention and seem more resistant to the damaging effect of frost, hot weather, and aphis than most cole crops.

Mustard appears not to be a feasible crop for the Salt River Valley. It is a low-priced seed which can be more economically produced in other areas.

Cabbage. The production of cabbage seed has been under observation and study in the Salt River Valley since 1939. Several experimental and commercial plantings have been made during the three-year period 1940-43. With the exception of an occasional small plot, successful yields of seed have not been obtained. This is particularly true of standard varieties. Savoy varieties have seeded reasonably well.

The failure of cabbage to produce seed well in the Salt River Valley appears to be caused by insufficient chilling during the winter months. Cabbage has one of the highest chilling requirements of the "biennials"! Evidence indicates that unless the winter has some 1,400 hours when the temperatures are 45° F. or below, reproductive bolting will not take place in the spring. The Salt River Valley normally experiences less than 1,100 hours of chilling.

Spinach. The production of spinach seed has not been successful in two years of study in the Salt River Valley.

Radishes. The production of radish seed has not been successful. The radish is an annual which blossoms within a relatively short time from seeding. Like the turnip, it would probably produce more seed if planted in late fall or early winter.

Endive and chicory. Seed of these two related crops has been produced abundantly in experimental plots. Yields have not been measured. Both crops have been grown for seed in other parts of the state in the past two years.

Salsify. This crop seeds readily and abundantly. No records of yields have been made.

Swiss chard. This crop has not produced seed successfully in the Salt River Valley. It appears to have about the same chilling requirements as cabbage.

Lettuce. Lettuce seed has been produced successfully both experimentally and commercially for a number of years. The lesser rainfall in the Yuma Valley appears to give that area an advantage for commercial production.

Cantaloupes. Cantaloupe seed has been produced experimentally for many years in connection with a cantaloupe breeding program. Yields of more than 300 pounds per acre have been common.

Herb Crops in Salt River Valley. In 1940, investigations of the growth and seeding habits of several condiment herbs were begun. During the three years from 1940-1943, considerable information has been gathered. Some of these crops could be grown in the lower irrigated valleys of Arizona if economic conditions warrant. The total demand is small, and many of them can probably be grown just as cheaply in other areas. The following condiment herbs have been studied most extensively.

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Anise. Table 7 presents data on production of anise seed obtained in 1942 and 1943. Planting the latter part of October has been found to give best results. Anise comes into flower in February regardless of when planted and is easily damaged by cold weather. If planted in November or December, blossoms tend to be produced before the plant reaches full vegetative maturity. This results in markedly reduced yields.

The tendency to blossom during the short days of winter is believed to be a photoperiod response. All of the herbs described in Table 7 tend to respond similarly.

Much of the anise seed harvested has been of low quality. It is doubtful whether this crop is adapted for production in Arizona.

French Celery. Table 7 gives data on seed production of this crop. It has produced exceptionally well. The most successful plantings have been made in late September. Plantings made later than November gave plants of small size at blossoming and consequently reduced yields.

Coriander. This crop is handled like anise. Although a yield of 4,000 pounds per acre was obtained in 1941, replicated trials since have not shown nearly as good results. Seed quality has not been good. It now seems doubtful if this crop is adapted.

Fennel. Data concerning seed production of this crop is shown in Table 7. It has produced successfully in the Salt River Valley. Best results have been obtained from plantings made in October. Yields of 1,500 pounds of seed per acre or better can be reasonably expected.

Frosts in January and February have repeatedly killed the apical bud, but after this injury fennel sends out numerous axial shoots which flower profusely. Yields, after the apical shoot is frozen back are often greater than if the shoot is undamaged.

Table 7

Effect of Planting Date on Yield of Herb Seed
1941-1942, 1942-1943

Year	Kind	Date Planted	Date of Harvest	Yields Pounds Per Acre
1941-1942	Anise	10/11/41	5/22/42	679
		11/11/41	5/25/42	828
1942-1943	Anise	9/25/42		*-1
		11/4/42	6/12/43	500
1941-1942	Celery	10/11/41	6/15/42	616
		11/11/41		*-2
1942-1943	Celery	9/25/42	6/4/43	2268
		11/4/42	6/15/43	694
1941-1942	Coriander	10/11/41	5/18/42	955
		11/11/41	5/20/42	730
1942-1943	Coriander	9/25/42	5/6/43	1694
		11/4/42	5/18/43	1414
1941-1942	Fennel	10/11/41	6/8/42	1525
		11/11/41	6/25/42	1555
1942-1943	Fennel	9/25/42	6/1/43	1772
		11/4/42	6/18/43	1636

*-1 Anise planting ruined by cutworm.
*-2 Plants grew normally but failed to set seed.

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Flowers for Seed Production

Opportunities for flower seed production have often been considered in view of the ease with which such flowers as Calendula, African Daisy, Venidium, Flox, Snap-dragon, Poppy, and others produce seed. This year in the Salt River Valley a successful yield of high-quality seed of Calendula was produced.

Santa Cruz Valley near Tucson
(Elevation 2,400 feet - 1,200 to 1,600 hours chilling)

In the 1942-43 season small experimental trials on the seeding of certain vegetables were made in the Tucson area. There was some commercial seed production. From all evidence the following performance for the various crops is indicated.

Cabbage. Cabbage of two varieties, Jersey Wakefield and Marion Market, were planted August 3 and transplanted to the field on September 15. Marketable heads were produced and removed in December and January. Axillary flower stalks made some growth during the cool weather, and by mid-March began to elongate rapidly, and first flowers appeared April 5. Flower stalks continued to grow and set pods for some six weeks. Seed matured in early June. It had a germination of 83%.

There was no record of yield, but indications of a fair to medium commercial crop were indicated. The production was much more encouraging than the Salt River Valley trials have been. Bolting was more thoroughly reproductive in type. However, some reversion to vegetative growth occurred as the temperatures increased in May.

Bolting and seed production appeared to be better where heads were cut and removed than where the heads were allowed to remain or were slashed. If cabbage seed can be produced in the mid-elevations of Arizona, it will be as one phase of the production of heads for market. This will provide opportunity for selection and roguing which should be a very decided advantage in maintaining and improving seed stocks.

With the recognition that the mid-elevations provide sufficient chilling for reproductive bolting and at the same time are not cold enough to cause freezing damage, it appears that the only climatic feature yet to be evaluated is the effect of early high temperatures upon reversion to vegetative growth. Also, spring frosts could cause damage to flowers and developing seed.

Aphids are always present and must be controlled. It is believed that thrips damage the flowers.

Onions. Utah Sweet Spanish onions were planted September 5 and thinned when "pencil" size to a four or five inch spacing. Bulbing and flower stalk formation took place in April and May. Full bloom occurred in late May and seed was harvested in late June and early July. No yield records were taken, but it was obviously of commercial proportions. Seed was of good quality.

A commercial field of onions grown for seed was under frequent observation. Satisfactory growth and bolting occurred. Failure to irrigate during the seed-forming period seriously reduced the yield of good seed.

Table Beets. Detroit Dark Red table beets were planted September 5. Market maturity was reached in December. Bolting began in late March, and full bloom was attained in early May. Seed was ready for harvest in late June. No record of yield was made but it would obviously have been of average commercial proportions. Curly top was present. Whether beet seed can be produced successfully when the roots are transplanted remains a question.

Swiss Chard. This crop was planted on the same date as the table beets. Growth and bolting were similar. Heavy seeding occurred in June. The seed germinated well where planted the following September.

The additional chilling and slower warming up in the spring at this elevation seems to make seeding of this crop possible, whereas in the Salt River Valley it has not seeded well.

Mangel Beets. A commercial field of mangel beets was planted October 10. This crop was grown under unfavorable conditions but gave evidence that climatic requirements suited. Yield was unsatisfactory, but indicated that good yields could be obtained if proper methods of bedding, fertilization, and irrigation were followed.

Salsify. A commercial field of salsify was planted September 18. Where soil fertility was good, a very satisfactory yield of good seed was obtained.

Carrots. Imperator and Chantenay carrots were planted September 5. The roots were of market size by January and were thinned to 3 inches. The plants remaining started to form flower stalks in early April, were in full bloom in early June, and ready for seed harvest in late July. The amount of seed produced was not determined.

Broccoli and Cauliflower. These crops were planted August 3 and transplanted September 15. They both produced some seed the following spring but flowered so early that damage from spring frosts occurred. At present these crops do not appear promising, although on a location with suitable air drainage they would likely be satisfactory.

Safford Valley

(Elevation 3,000 ft. - 1,400 hours of chilling)

The hours of chilling at Safford are recorded at the Buena Vista Hotel by the courtesy of Mr. Charles Waughtal. It is likely that this location is slightly warmer than in the farming area of the valley, particularly the lower lands. It is believed that sufficient chilling occurs in this area to induce seed production of any of the vegetable crops.

Information in 1942-43 was obtained chiefly through cooperative trials with Mr. John Carpenter, Thatcher.

Cabbage. Cabbage plants in the experimental trials were retarded and blossomed late. There was marked reversion to vegetative bolting. Results were not indicative of successful cabbage seed production, yet conditions were not such as to give a fair trial. In a private garden early cabbage seeded more satisfactorily. Seed produced had 82% to 98% germination.

Onions. Utah Sweet Spanish onions were planted August 18 and September 29. Both bolted and produced seed. The August 18 planting was much superior to the September 29 planting. Seed produced was of good quality. No yield records

were kept, but it would obviously have been a satisfactory commercial yield. Germination of 86% to 97% was obtained.

Carrots. Chantenay carrots were planted on the same dates as onions. Roots matured before cold weather which killed most of the tops. Bolting began in early April, and was strongest and most uniform from the early planting. Flowers opened in May and seed was ready for harvest in late June and July. Yield was not measured, but was obviously of commercial proportions. Germination was from 94% to 98%.

Beets. Perfected Detroit beets were planted on the same dates as onions and carrots. Roots reached commercial maturity by mid-winter. Curly top was observed in March and continued to be severe. Bolting began in early April. It was strongest and most uniform on the early planting. Flowers opened in early May. Seed began to ripen in late May and was ready for harvest by late June and early July. The early planting produced large flower heads and was apparently least damaged by curly top. It was apparent that a satisfactory commercial yield was produced in spite of curly top although no yield records were obtained. Germination of seed was from 76% to 95%.

Turnips. Purple Top White Globe turnips planted on the same dates as onions produced marketable roots in late fall. Bolting began in late February. Full flowering occurred in late March and early April. Seed ripened in late April and early May. Aphis infestation was severe and destroyed most of the seed.

Sulfur Springs Valley, San Simon Valley, and Duncan Valley
(Elevation 3,600-4,200 feet, No record of hours of chilling)

Trials in these areas were similar to those conducted in the Safford valley and were in cooperation with Mr. Frank Murphy, at McNeal, Mr. J. L. Schad at San Simon, and Mr. E. L. Hancock at Duncan.

It was apparent that all of the crops under trial might have possibilities of succeeding commercially.

Cabbage tests, unfortunately, were not conclusive. Some growers report having produced cabbage seed in previous years. On the other hand, a virus disease affecting cabbage flowers may be serious. This was discovered by Dr. J. C. Walker, University of Wisconsin plant pathologist, on April 22, 1943. The disease is unidentified and may be related to curly top of beets or to aster yellows. Its seriousness is so far unevaluated. Similarly, in some of these areas there may be danger of the outright freezing of cabbage during the winter months. This would be likely only where an early planting to produce an early fall crop of heads is made.

Onions have uniformly seeded well and their adaptation either on "seed to seed" or "seed to bulb to seed" production is attested to by many years of small commercial production in the Duncan and Sulfur Springs Valleys. Yields of 400 to 600 pounds per acre are commonly reported. Seed of more than 90% germination was produced in all of the experimental plantings.

Beets seeded uniformly, although curly top was present to a greater or less extent in all locations. Germination was from 55% to 86%. No tests with transplanted beets were made.

Carrots planted in the early fall and carried over the winter produced edible roots in the early winter. Tops were generally killed by frost, but strong and uniform bolting occurred in the spring. Seed yields were obviously of commercial proportions. Seed produced at Duncan had only 58% germination, but that at McNeal and San Simon had 96% and 97% respectively.

SUMMARY OF VEGETABLE SEED PRODUCTION POSSIBILITIES IN ARIZONA

From evidence gained thus far, it is evident that many kinds of vegetable seed can be produced successfully in Arizona. Those best adapted seem to be the hardy annuals and biennials, although certain tender crops such as cantaloupes also have possibility.

The following chart gives the approximate adaptation of the crops to the various areas in the state as best known at the present time.

Location	Elevation	Hours of Chilling*	Crops Adapted	
Yuma	140	800	lettuce	
Phoenix	1090	1100	endive	
Eloy	1620	----	salsify	
			cauliflower	
			broccoli	
			carrot	onion
Tucson	2390	1600		carrot
Safford	2922	1400		red beets
Camp Verde	3000	2500	cabbage	mangels
Cottonwood	3315	----	chard	
San Simon	3612	----		
Duncan	3643	----		
Willcox	4166	----		

*When the temperature is 45° or below.

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One year's trial on the Production of Vegetable Seeds and the Growth of Herbs and Related Plants in Arizona

by

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For many years the United States has depended upon foreign sources for seed of some of our common vegetables crops and for the supply of many medicinal and culinary herbs in which either the seeds or a vegetative portion of the plant is used. Present world conditions have restricted importations of those items to the extent that shortages of some exist and domestic prices have risen. As a result interest in their production has been manifested throughout the United States. The purpose of this paper is to report the results of one season's trials aimed at answering the question, which has been asked by a number of residents of Arizona, "Can these seeds and herb plants be grown here?"

THE PRODUCTION OF VEGETABLE SEEDS

In addition to the studies with the important commercial vegetable crops of southern Arizona the Arizona Experiment Station has for the past several years conducted systematic trials of new strains and varieties of miscellaneous vegetables on the Experimental Farm at Mesa. In 1940 approximately 300 varieties and strains of vegetables were planted on September 20. Data on the time of maturity, the quantity, and the quality of the edible portions were obtained. These data will be presented in a separate report.

After harvesting the edible portion most of the vegetable plots were allowed to go to seed, and in certain cases the cured seed was threshed, cleaned, weighed and yields calculated to an acre basis. On others, only observational notes on the general success of seeding were taken.

Cauliflower

Cauliflower was seeded in the field and later thinned to 2 feet between plants. Both sides of a 3-1/2 ft. bed were planted. Commercial harvest of the edible portion began January first and continued until the fifteenth of February.

Twelve 15 ft. plots of the Snowball type were left for seed. Elongation and flowering commenced January 25. Seed pods were fully formed by the middle of April. All plots were harvested on the fifteenth of May. In order to avoid shattering, the plants were harvested before the pods were thoroughly dry. Final drying took place in a cool, well ventilated adobe building.

After threshing and cleaning a total yield of 260 pounds per acre was obtained. This is well above the average commercial yield of 125 to 175 pounds per acre. The

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seed was well filled, large and bright, and equivalent to most of the material in commercial channels.

It is possible that the unusually moist fall, winter and spring of 1940-41 were especially favorable for the production of this difficult seed crop. However, the relatively long, cool growing season characteristic of the Salt River and Yuma Valleys may, in general, be satisfactory for the production of cauliflower seed.

In view of the success of these trials and the fact that the only serious pest of the cruciferous crops seems to be the aphis, which can be controlled, experimental work in the production of cauliflower seed is to be continued.

A few small commercial plantings have been attempted with fair success. It is advised that individuals desiring to produce cauliflower seed should proceed cautiously. The source of stock seed should be carefully examined, and initial plantings should be small. Cauliflower seed is recognized as a difficult crop to grow.

Broccoli

Broccoli, of the Italian Green Sprouting type, was planted and cultured much the same as cauliflower. Commercial harvest of the edible portion began December 26 and continued throughout January. Early types flowered in January, with seed ready for harvest in early March. Later types were ready for harvest in April and early May.

Plots of an Intermediate Italian Green Sprouting broccoli were harvested on May 11. Procedure was the same as for cauliflower, an average yield of 850 lbs. per acre was obtained.

The principles of broccoli seed production are about the same as for cauliflower. However it is not as difficult to produce for it seems to yield well under less favorable conditions than cauliflower. Small experimental plantings made by commercial interests, have been relatively successful.

Brussels Sprouts

Did not seed readily.

Radish

The various varieties bloomed profusely during February. Early Scarlet Globe types seemed to seed more readily than other varieties. Pod setting was sparse due possibly to unfavorable climatic conditions at time of pollination. Pods set contained no seed. Aphis infestation was serious. This year's trials were not successful and indicated that some study may be necessary if radish seed are to be grown successfully.

Collards

Collards bloomed profusely in January. The seed pods mature in April. The yield was extremely heavy. Aphis is the only serious pest. There should be no difficulty in producing seed of this crop.

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Chinese Cabbage

Chinese cabbage bloomed early in January. The seed pods matured in late March. An extremely high yield of bright, plump seed was obtained. Aphis was the only serious pest. This crop gives promise for successful seed production.

Kohl Rabi

Kohl Rabi bloomed in late March. Pods and seeds matured about June 15th. Purple types yielded more seeds than green but all yields were good. Aphis control was necessary.

Kale

Kale bloomed in April and set seed pods which later dropped off before maturing. Results were unsuccessful.

Rutabaga

Results same as for Kale.

Cabbage

Cabbage bloomed in April but the seed stalk formation was not uniform within varieties. For best seedings this crop apparently needs greater chilling than obtained during the winter of 1940-1941. Part of the seed crop was mature June 15th. A fair yield of plump, bright seeds was obtained.

This crop needs further study but the indications are that it would seed more successfully at higher elevations. It should be tried at Safford. In higher elevations to avoid freezing the usual process of lifting the heads in the fall, storing them at temperature of 40-45° F and resetting in the spring, would no doubt be necessary.

Beets

All varieties of table beets bloomed profusely April 15 to May 1. Seed balls were dry and ready for harvest in late June. Excellent yields of good quality seed were produced. A further study of planting dates is desirable. Garden beets should give little trouble in seed production in the Salt River Valley.

Swiss Chard

Swiss Chard bloomed in May. Seed stalk formation and flowering were uneven and each of the harvest could not be made until late summer. Not promising.

Onion

Bunching varieties were in full bloom during late March. Bermuda, Spanish and other large bulb types bloomed during late April and early May. Seed of later types were ready for harvest in early July. Yields were heavy and seed were well filled and bright. Mildew may be serious, and the failure of plants to bulb

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properly would offer difficulties in selection of seed stocks. This crop needs further study before attempting commercial production of seed in the lower valleys. That onions seed successfully at higher elevations is well known.

Carrot

Seeding of carrots was not uniform. It appears to require more chilling than commonly experienced in the Salt River Valley. However, it would seem to have distinct possibilities for seed production at higher altitudes. The commercial production of carrot seed is being tried at altitudes of 4000 - 5000 feet during the growing season of 1941.

Endive

This crop seeds readily and profusely. Harvest began about June 15. There should be no difficulty in producing seed commercially.

Salsify

Salsify bloomed heavily during April. Seeds were harvested during May. Yields of seed were satisfactory and promising. However, demand for this crop is limited.

HERBS AND RELATED PLANTS

Many of the herbs are native to an arid or semi-arid region. Others are more adapted to cool and moist environments. Within Arizona there are production areas which should meet the climatic conditions necessary to the growth of a number of the common herbs. However, most of the medicinal and herb crops require special extraction and drying equipment. Much hand labor is involved. Definite quality standards of the product must be met. Dates of planting and cultural methods must be learned.

The aggregate volume of herbs used is rather large, but the amount of individual ones is relatively small so that markets can easily be gluted. With the wide spread interest in herbs that is now being manifested throughout the United States it appears likely that over production will occur in many lines. This would be especially true if stocks which must have accumulated in foreign lands were suddenly liberated.

The production of herb seeds would involve less new equipment than production for medicinal or culinary channels. Because of this the herbs, with the exception of chicory, have been studied from the standpoint of seed production. It is necessary with most of the herbs discussed in the following pages, to harvest before full maturity, in order to avoid shattering.

Chicory

This crop has commercial use chiefly in that the dried ground root is an ingredient in certain blends of coffee. The Large Red and the Witloof varieties of chicory were seeded in raised beds on September 20, 1940. Plants were thinned to stand 10 inches apart. Each bed had two rows. Roots were harvested in April. The root of the Witloof type was broader at the shoulder and shorter than the root of

the Large Red Variety. It was also rougher and had more side roots. Data taken on this crop are shown in the following table.

	Witloof	Large Red
Green weight per root	444.5 grams	292.5 grams
Dry weight per root	98.5 grams	78.8 grams
Percentage water	78%	73%
Yield per acre green weight	29,200 lbs.	19,200 lbs.
Yield per acre dry weight	6,500 lbs.	3,300 lbs.

The estimated yields per acre were based on plants 10 inches apart, 2 rows per 3-1/2 foot bed. The total yield figures should be accepted with caution but are probably a reasonable estimation of what might be expected.

Roots of both varieties were roasted at 140° C and the resultant product was ground. The material was of a deep reddish brown color and with an odor suggesting coffee. No chemical or other tests have been made.

The production of chicory for the root appears feasible in Arizona. However, before commercial plantings are made, production methods, and marketing channels should be carefully studied.

Chicory seeded readily and profusely. The present crop could be harvested from July 1 to August 1.

Dill

Green, flower heads of dill are used in the flavoring of pickles and as garnishes. Oil extracted from the seeds is used in soaps and medicines. At present, the seeds are being substituted for caraway in the making of bread, caraway being unobtainable. The plant thrives best in a warm climate on a well-drained soil.

Seeds planted in October and thinned to 10 inches resulted in plants 7 to 8 ft. in height. In order to avoid shattering, the seed stalks and heads were cut before the seeds were fully dried. Shocks were placed on canvas in a shaded place and allowed to cure.

A yield of 2900 lbs. per acre of bright, viable seed was obtained. This is considerably higher than the average of 500 to 700 lbs. Aphis was the only serious pest.

Dill production is an established industry in other sections of the United States, so careful study of market demands should be made before planting large acreage.

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Coriander

Oil distilled from the seeds of this herb is used medicinally and in confections.

The plants thrived, making an excellent growth and setting a heavy crop of seed.

Seeds were planted October 30 and plants were thinned to 6 inches, but ten inches would probably be more desirable. The plants thrived and seemed well adapted. A yield of 4000 pounds per acre was harvested in early April. This is above the average. In the past between one and two million pounds of coriander seed has been imported each year. Under the present conditions, the crop is promising for southern Arizona.

Anise

The seeds of this are used in medicine and confection. The plant does best in a warm climate on a moderately light, well drained soil.

It was planted October 30, and harvested in late May. A yield of 400 lbs. per acre was obtained. The average is 400-600 lbs. The seeds were not well filled and in many cases were not viable. This crop needs further study, but at present it is not promising.

Summer Savory

The dried leaves of this plant are used as seasoning for soup, meat, and poultry.

Seeds were planted October 30. A yield of 1650 lbs. of dried leaf per acre was harvested in March. Seed ripened uniformly but shattered before harvest. As a seed crop it would need special care and much hand labor.

Parsley

This was planted September 20. The plants made continuous growth throughout the winter. Seed could be harvested about July 15. Seed set was extremely heavy. It seems promising for seed production in limited quantities. Its growth in home gardens is well known.

Sage

The planting of sage was established from seed and from root division in the fall of 1940. This is a perrenial crop so results at the present time are not highly indicative. The plants thus far are doing well. However, it is suggested that sage be considered for higher elevations than that of the Salt River Valley. That it will produce well in these higher districts is commonly known.

Considerable amounts of sage are used in this country. Shortages due to the shutting off of European sources are in evidence. If consistent production areas can be established the market for American grown sage should be firm, until foreign supplies are liberated. Even than commercial sage production might be possible in our higher elevations.

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Florence Fennel

Planted October 30 and could harvest July 1. The seed yield is heavy. This crop is promising for southern Arizona but the market is limited.

Sweet Basil

This is used as flavoring in tomato and meat cookery. Seeds were planted October 30. There was but little growth until late March. A light yield of seed was produced in June. Not promising. It probably should be planted in early spring and grown as a summer crop.

Sweet Marjoram

This is used as seasoning in certain foods and the extracted oil is used in soaps. Seeds were planted October 30, the plants grew well throughout the winter months and went to seed in June. It is hardy and well adapted to southern Arizona. Market limited.

Caraway

Caraway seeds are used in bakery and confection trades. Extracted oil is used in perfumes and soaps. Seeds were planted October 30. The plants grew slowly throughout winter and did not produce seed stalks before July 1 when high temperatures stopped all growth. This plant may seed more easily and would probably be better suited at slightly higher elevations where more winter chilling is experienced.

Pyrethrum

The flowers of this plant provide the base for many insect poisons and fly sprays. They are imported from the orient.

Trials with pyrethrum have been conducted cooperatively with the U. S. Department of Agriculture at Tucson and in the Salt River Valley for some half dozen years. A major problem has been the loss of plants from an unidentified disease - apparently one of the root rots common to southern Arizona. A good yield of flowers and pyrethrins has been obtained from healthy plants. Plants have done best at Tucson and it is likely that a still higher altitude would be better.

Tapioca

The roots of the tapioca or cassava plant are a source of the edible tapioca but are most important as source of starch for the manufacture of mucilages. Several million pounds are imported annually. This plant has been grown on the Yuma mesa for the past three years and seems well adapted. Roots have tuberized well and contain considerable starch. More accurate yield records and starch measurements will be obtained this year.

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STATE COLLEGE OF WASHINGTON
WESTERN WASHINGTON EXPERIMENT STATION
PUYALLUP, WASHINGTON

INFORMATION AND SUGGESTED PROGRAM FOR PREVENTION OF BLACK BLIGHT (MYCOSPHAERELLA RING SPOT) OF CABBAGE.

Mimeograph
Circular No. 111. Glenn A. Huber, Plant Pathologist June, 1942.

The following information on "BLACK BLIGHT" and suggested program for the prevention of the disease is based on observations and experimental investigation made by the writer to date - June 1, 1942.

LIFE CYCLE OF ORGANISM:

1. Preliminary experiments indicate that the causal organism is seed borne.

2. Primary infections may take place in plant beds from infected fields and straw stacks; or, primary infections may take place after the plants have been set in the fields from adjoining infected fields and straw stacks.

3. It takes approximately two months during fall, winter and early spring, from time of infection, until the resulting leaf spots produce mature spores (seeds) and subsequent infections take place.

4. By the beginning of the blooming period the disease (organism) population has been built up to the point that continuous infection takes place throughout the remainder of the season. Infections take place and diseased areas appear on the leaves, seed stalks, pedicels and seed pods.

5. The organism may pierce the pods and grow into the seed.

6. The organism develops and produces spores (seeds) on the plant parts left in the fields after harvest and on the straw in the stacks.

7. The disease develops on volunteer plants that grow during the fall in unplowed fields that have just produced a crop.

SUGGESTED CONTROL PROGRAM:

The following program is suggested for the 1942-43 cabbage seed crop, based on our present information.

1. Select plant bed where cabbage has not been grown recently and not adjoining cabbage fields.

2. Treat seed in hot water at 45° to 46° C (114° to 116° F.) for 20 minutes. Dry. Treat with zinc oxide (2% by weight), calomel (as much as will carry), or "thiosan" (tetramethyl thiuramdisulfide - 2% by weight).

3. Burn, IMMEDIATELY after harvest, all cabbage straw stacks and plow fields that have just produced a crop.

4. Remove lower leaves of plants when lifting from plant bed.

5. Cultivate to cover lower leaves of plants even if infections may not be observed. The removing of infected leaves during the fall helps to keep down spread of the disease.

6. Spraying and dusting have not proved satisfactory in controlling the disease in the field during the spring and early summer.

REMEMBER, AN OUNCE OF PREVENTION MAY BE WORTH MORE THAN 100 POUNDS OF CURE.

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ANOTHER SEASON'S RESULTS ON THE PRODUCTION OF VEGETABLE AND HERB SEEDS IN ARIZONA[1]

August 1942

by

A. E, Griffiths and A. H. Finch
Department of Horticulture

THE PROBLEM

As reported a year ago, most medicinal and culinary herbs and many kinds of vegetable seeds have been imported to the United States from Europe, Asia, and Africa. These sources are now practically closed so that the United States must depend largely upon domestic production to supply its needs. In addition, under the Lend-Lease Act this country is committed to the production of seed for export to the United Nations. This situation has greatly increased the demand for seeds and has focused attention on the finding of new areas where these seeds can be produced successfully.

THE SUITABILITY OF ARIZONA FOR SEED PRODUCTION

Trials on the production of vegetable and herb seeds have thus far been conducted chiefly in the Salt River Valley. Knowledge gained from them and from observations on the growth and seeding of various vegetable crops in other parts of the State have revealed some advantages and disadvantages which the lower and mid-elevations of the State may possess.

There seems to be little possibility in Arizona, particularly in the low altitudes, for the production of seed of the tender annuals such as peas, beans, corn, and tomatoes, although some opportunities may exist in certain areas for seed production of those which tolerate moderately high temperatures, such as peppers, melons, and okra.

The best opportunity, and possibly an advantage, appears to be in the winter growing of the cool-climated hardy annuals and biennials. The annuals being those which will complete their growth cycle from seed planting through to seed harvest in one continuous period. The biennials are those which must have a period of chilling and dormancy after a degree of vegetative maturity is obtained before they will "bolt," produce flowers, and mature seed. For producing seed of these types some advantages inherent to conditions in Arizona have so far appeared. The following are listed:

1. Less time is required for maturing the crop.

The normally biennial plants require two growing seasons to produce seed when grown in regions having cold winter temperatures. They are planted in the

[1]Preliminary trials of vegetable seed production in Arizona were initiated in the fall of 1939-40. In 1940-41 these were extended and herbs included. A mimeographed report was issued in July 1941.

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spring or early summer, make a vegetative growth the first year, and are carried through the winter either by covering in the field or by digging the plants and placing them in a storage house. This storage at cool temperatures provides the necessary chilling to cause them to flower and seed when grown the second year.

In Arizona these types are planted in late summer or fall and complete their vegetative growth before cool weather. They complete their dormancy without the necessity of digging and generally without danger of freezing. In the spring they resume growth, come into flower and produce seed which is ready for harvest in early summer.

For the annuals or biennials which require little if any chilling, the low elevations at Phoenix and Yuma are suited. The true biennials having a greater chilling requirement will probably have to be grown at elevations of 2,500 to 4,000 feet.

2. Freedom from Disease (by R. B. Streets).

Because of the prevailing dry atmosphere there are relatively few leaf diseases such as leaf spots, rusts and mildews which attack vegetable crops. Those which do occur are usually sporadic, causing commercial damage one year out of perhaps five or ten, and being relatively mild in average years.

Downy mildew of lettuce and downy mildew of onions are examples of diseases of sporadic occurrence. Curly top of garden beets, swiss chard, spinach and some other crops may occur, but are usually not serious on winter grown crops.

Cabbage, cauliflower, broccoli, brussels sprouts and other related crops are more or less subject to the same kinds of diseases. Yellows caused by a fungus which persists in the soil is less prevalent in the winter grown cabbage, and is controlled only by the use of resistant varieties which have been developed for nearly all the important commercial types. Black rot, a bacterial seed borne disease, is important some years in cauliflower and cabbage. It is controlled by seed treatment. Club root and Black leg have not been found in this state.

Some soil-inhabiting parasites such as the root-knot nematode are present but are not often serious to winter grown crops. However, infested soils should be avoided.

3. Absence of rainfall during seed harvest.

The rainfall during May and June is normally very light. These are the months when seed of most of these biennial plants is harvested. Little difficulty from rain at harvest time would normally occur.

4. Isolation.

For most items it is possible to obtain complete and certain isolation.

Following are some of the disadvantages and problems which present experience indicates may be encountered.

1. The chilling requirements of the particular crop must be fulfilled.

Those crops which require chilling before they will produce seed (ie. biennials) probably can not be grown successfully in the warmest valleys. As an example cabbage does not appear to receive sufficient chilling in the Salt River Valley. Some evidence indicates that it requires some 1400 hours of chilling.

By selecting the proper elevation the amount of chilling necessary for any of the biennials can probably be obtained. Temperature records are available for a long period of years for some locations and for some others they have been kept for one or more winters. These indicate the average number of hours of chilling (45° F or below) to be approximately as follows:

Location	Number of hours of chilling
Yuma (Mesa)	400
Yuma (Valley)	800
Tempe Date Garden	1100
Tucson (U of A)	1100
Tucson (Valley floor)	1600
Safford (at Buena Vista Hotel)	1400
Campe Verde (near valley floor)	2500

2. The proper planting date must be used.

Planting must be done in time to provide a plant of large frame before cool weather arrives. The best planting date for the different crops in the different areas is still largely to be determined.

3. Damage may be experienced by late frosts.

Warm weather in early spring may bring on flowers early enough to be damaged by late frosts. To reduce this hazard sloping land which permits the cold air to drain off should be used, and crops which have little or no chilling requirements and, hence, begin growth early, should be planted only in the warmest areas.

4. Insect pest control is necessary (H. G. Johnston)

There are many insect pests attacking vegetable crops, especially when carried through the winter for seed production. Cutworms attack small plants of many kinds of vegetables. Onion thrips are generally present and in some cases have caused damage. Aphis (plant lice) regularly, and the false chinch bug occasionally, have been especially serious on cabbage, cauliflower, and broccoli. These insect pests can be controlled if measures are undertaken early and applied diligently. (For methods consult your County Agricultural Agent.)

THE 1941-42 TRIALS

In the fall of 1941 vegetable plantings were made at the University Date Garden near Tempe, and on the Yuma Valley and Yuma Mesa Experimental Farms near Yuma. The herb plantings were made on the Yuma Mesa, at the Date Garden, and on the Mesa Experimental Farm.

The vegetable plantings were made in single 1/100 acre plots. In most cases several varieties of each kind of vegetable were planted and, while some varietal differences in seeding were noted, all varieties of each vegetable tended to perform much alike, thus giving the effect of replicated trials.

The herb plantings were made in 1/200 acre plots in six replications.

All vegetables and herbs were planted in double rows 18 inches apart, on a standard 40-inch lettuce bed. The spacing of plants within the row varied from 4 to 6 inches for anise, fennel, coriander, caraway, celery, and beets, to 2 to 3 feet for sage, marjoram, broccoli, and cabbage. All of the seeds were planted on the dry bed and irrigated up. Irrigations were roughly at 10-day intervals from October to January; 2-3 week intervals from January to April, and at weekly intervals from then to harvest.

The seed was harvested by cutting the stalks before it shattered. Threshing was done by hand. The yield of seed reported is on a recleaned basis.

RESULTS OF THE 1941-42 TRIALS

I. Vegetable Seed Production

Table beets

Seven varieties of table beet were planted in two replications at the University Date Garden at Tempe, on October 12, 1941. Seedlings were thinned to 6 inches apart. Marketable roots were produced in January 1942. Seed stalk elongation began in late March. A heavy crop of full, viable seed was harvested on June 20, 1942. The average yield was 3,162 pounds per acre. Differences as great as 1,578 pounds per acre were observed between varieties, with the Detroit Dark Red variety producing the lowest seed yield. Yields are shown in Table 1.

Table 1.--Yields (Pounds per Acre) of Seed of Various Table Beet Varieties at Tempe Date Garden. Planted October 12, 1941. Harvested June 20, 1942

Variety	Yield
Detroit Dark Red	2,233
Crosby	3,374
Early Wonder	2,843
Green Top Bunching	3,811
Early Red Chief	2,793
Bravo	3,539
Black Red Ball	3,539

Red beets have regularly produced a good crop of seed in Salt River Valley trials. Observations on the performance of small plots near Tucson and in the Sulfur Springs Valley indicate that it can be expected to seed well from elevations of the Salt River Valley up to perhaps 4,000 feet. It apparently requires somewhat less chilling than sugar beets.

Table beets cross readily with sugar beets and with stock beets. With sugar beet seed being grown extensively in the Salt River Valley it is unlikely that seed companies will be interested in the production of red beet seed in that area. The smaller isolated valleys have promise for this crop.

In the commercial production of table beet seed it is necessary to dig the beets at market maturity, rogue out the undesirable types and replant, using only the desirable ones.

Swiss chard

This crop is closely related to beets and will cross with them. However, production of seed again this year was not nearly so successful as for beets. Seed stalk formation and flowering were again uneven and seeds did not mature until mid-July. The seeds were shriveled--a result of ripening during high temperatures.

Further studies on planting date for swiss chard are necessary before making conclusions as to its adaptation in the Salt River Valley, but present indications are that this crop requires more chilling than occurs in the Phoenix area. It is possibly better adapted to mid-elevations where some reports and observations indicate that it has seeded satisfactorily in small gardens.

Broccoli

Five varieties of broccoli were seeded in the field on one side of a 40-inch bed on October 12, 1941. On November 15 the seeded rows were thinned and plants were transplanted to an additional bed. The transplanted plants seemed to be about two weeks behind the seeded plants until just prior to market harvest, from January 15 to February 5. After this only slight differences in maturity existed.

By late February all but the late strain of broccoli were in full bloom. Seed harvest began on May 22 and continued through June 15. When all varieties were considered there seemed to be little difference between the yield of plants grown directly from seed and those transplanted. Yields are shown in Table 2.

Table 2.--Yields of Broccoli Seed. October 3, planting was on Yuma Mesa all others were at the Date Garden

Variety and treatment		Planting date 1941	Harvest date 1942	Yield pounds per acre	Varietal average
Early Calabreese	S*	Oct. 12		551	735
	T	Nov. 5	May 22	919	
Xmas Calabreese	S	Oct. 12	May 22	900	771
	T	Nov. 15		643	
Green Sprouting Early	S	Oct. 12	May 22	553	515
	T	Nov. 15		478	
Gr. Sprouting midseason	S	Oct. 12	May 22	404	579
	T	Nov. 15		753	
Gr. Sprouting late	S	Oct. 12	June 15	414	414
	T	Nov. 15		414	
Gr. Sprouting midseason	S	Oct. 3	Apr. 27	374	

*S - Seeded in field.
T - Transplanted

The earliest varieties, which produce the most open and poorest type of market broccoli, yielded the greatest amount of seed. The late types gave the smallest yield.

Growth of broccoli on the sandy soils of the Yuma mesa is not sufficiently vigorous to produce commercial yields of seed. In the Salt River Valley, broccoli seed is being produced commercially with a fair degree of success. From these commercial operations and from the experimental trials of the past three years, it is apparent that the climate of the Salt River Valley is well suited to broccoli seeding. This crop appears to require relatively little chilling and could probably be grown in the Yuma Valley where soils are more suited to this crop than those of the mesa. It is un-tried in the higher elevations where there might be danger of damage to flowers from spring frosts.

In the Salt River Valley the greatest problem in broccoli seed production has been the control of the false chinch bug and aphis. To avoid losses from these insects it is necessary to start control measures at the first appearance of the insect in the early winter and apply them diligently until danger is past. For information on control, consult your County Agricultural Agent.

Cauliflower

The test plots this year were planted too late (October 12) for the plants to obtain sufficient size before cool weather. The plants blossomed in March and April, but because of the small size of the plants, blossom heads were not

large. A late spring frost occurring while flowers were out further damaged the crop. No seed was harvested.

Cauliflower appears to be much like broccoli in its requirements for seed production. Present evidence indicates that it may require even less chilling during the winter and may bloom somewhat earlier in the spring than most broccoli varieties. Hence, it is adapted to slightly warmer areas than is broccoli. For its production the warmer parts of the Salt River Valley seem suited. It would probably seed well in the Yuma Valley.

Planting should be made in early September to give large plants before cool weather. These set larger blossom heads and blossoms open over a longer period reducing the frost hazard.

As for broccoli, the false chinch bug and aphis are major pests and must be controlled.

Cabbage

As in the trials reported a year ago, the standard varieties of cabbage failed to produce seed. There is some possibility that an earlier planting date might give better seed production but the present evidence is that insufficient chilling occurs in the Salt River Valley for this crop to seed satisfactorily. This is manifested in two ways: seed stalks are produced irregularly and instead of bearing flowers they produce miniature heads. Physiologists who have worked with cabbage seeding in the greenhouse find that cabbage must be subjected to some two months of cool storage when the plants are heading. If they are not given this period of chilling, seed stalk formation is irregular and small heads instead of flowers form on the stalks.

The present indication is that cabbage cannot be expected to produce a good crop of seed in those valleys of Arizona having less than 1,400 hours of chilling (45° F. or below) during the winter. This would limit seed production to elevations of some 2,400 feet or more. While no trials have been made in those elevations and no cabbage seed has been produced commercially, some vegetable growers in the Tucson area and in the Sulfur Springs Valley report that cabbage planted for the early market but allowed to stay unharvested in the field goes to seed readily. Since cabbage is one of the crops in which new seed areas are most badly needed, more study of its behavior in the mid-elevations is being undertaken.

In the Salt River Valley various types of savoy cabbage seeded readily and produced large yields of viable seeds. Commercial production of this type of cabbage would be doubtful because good market type heads do not form satisfactorily in the Salt River Valley and no selection could be made.

The cabbage aphis and false chinch bug have been serious pests.

Brussels sprouts

This crop did not seed readily. It appears to have the same climatic and other problems as standard varieties of cabbage.

Kohl Rabi

This crop seeded profusely in June. Since this is not an important seed crop, no yield records were taken. It is apparent that it would produce seed well in this area.

Insect problems are similar to those of cabbage.

Turnips and rutabagas

Three varieties of turnip and two varieties of rutabaga were planted at the Date Garden. The turnip reached marketable maturity by December 20, while the rutabagas were not mature until February 15. Both crops matured seed in May.

The Purple Top White Globe and the Golden Ball varieties of turnip did not produce seed heavily. Blooming occurred during long periods of cold weather in midwinter and at harvest most seed pods were empty. Apparently the cold weather had interfered with proper pollination. The Purple Top Strap Leaf and both strains of rutabagas bloomed in March and were not subjected to extended periods of cold weather. Consequently, a fair yield of seed was harvested. Yields are shown in Table 3.

Table 3.--Yields of Turnip and Rutabaga Seed (Pounds per Acre) Tempe Date Garden. Seed planted Oct. 12, 1941. Harvested May 29, 1942.

Variety	Yield
Turnip	
Purple Top Strap Leaf	165
Golden Ball	18
Purple Top White Globe	70
Rutabaga	
American Purple Top	239
Particular	184

At the present time it is doubtful whether turnip offers much possibility for commercial seed production in southern Arizona. Studies of planting dates must be made. Rutabaga is a promising crop both for market and for seed production.

Radish

Radish was grown on the Date Garden. It failed to produce a satisfactory seed crop again this year. This was partly because of the high mortality of roots during the winter and the consequent loss of stand.

This crop appears to be one of those which requires no dormancy period for seed production and which produces seed in a relatively short time from planting. A mid-winter or early spring planting might be more successful. It might seed well in the warmest valleys from a fall planting.

Onion

Two plantings of onions for seed production were made at the Date Garden. The first was a seed planting made on October 12 of Crystal Wax, Sweet Spanish, and Babosa. The second was of selected bulbs of the Babosa on November 15.

Bulbs of all three varieties from the seeded planting were mature and ready for market by mid-April. The Crystal Wax bolted soon after the bulbs matured and was followed shortly by the Sweet Spanish. The Babosa variety bolted later and very sparsely. Because of this resistance to bolting from seed planting and for other reasons, the Babosa is becoming a popular commercial onion. Its seed production is difficult because of this characteristic. The selected Babosa bulbs bolted in late March; seed heads, however, were sparse.

The seed crop of all varieties was light, in part because ripening extended into the high summer temperatures and no yield records were taken. The lateness of ripening this year may have been due to the retardation of growth by the cool spring.

Commercial production of onion seed in the Salt River Valley expanded to the extent that several hundred pounds were harvested in the early summer of 1942. It is apparent that in the Salt River Valley most varieties will yield reasonable crops of seed from a seed planting made early in the fall. For heaviest yields or for later planting, bulbs appear to be better. The smaller valleys of three to four thousand feet elevation appear to have slightly better possibilities for commercial onion seed production in that a more uniform and complete bolting of the bulbs seems to occur and larger seed heads are produced.

A further advantage of the mid-elevations is that the seed ripens during cooler temperatures and, hence, there is less danger of shriveling.

Onion seed has been produced semi-commercially in the Duncan and Sulfur Springs valleys for many years. The total amount has been small and for the most part has been used locally. The varieties and strains have often not been too well purified or standardized, and isolation has not always been satisfactory. But from these small endeavors the possibility of producing onion seed in substantial quantities and of satisfactory purity has been revealed. Yields are reported to range from 400 to 800 pounds per acre. Planting dates have been determined and other problems evaluated. It seems that with the use of strains of recognized purity, with a careful control of isolation, and with rogueing practices that any good seed company would require, these areas can readily produce onion seed of merit.

The rogueing of onion fields is usually done without digging the bulbs since a large part of the bulb is above the ground. Foundation stock should be produced each year from selected bulbs. The continuous planting of seed constitutes a selection of early bolting types.

Carrot

The experimental trials this year did not include carrot. However, observations on the performance of this crop at elevations ranging from less than 200 feet at Yuma to nearly 4,000 feet in the Sulfur Springs Valley have been made.

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In the Yuma Valley seeding has been observed to be generally light. This is especially true with transplanted roots. In the Salt River Valley somewhat better results from transplanted fields have been observed. But it is doubtful if these would be commercially successful. Some fields grown from seed without transplanting have bolted well and have produced reasonably good yields.

In the Tucson area, at Safford, and in the Sulfur Springs Valley, excellent seeding of carrots in small gardens has been observed. These have all been from seed planted in the fall. So far as is known, no attempt has been made to transplant roots in these areas.

Carrot is generally classed as a biennial and the above observations indicate that some chilling is required. However, no conclusions can be drawn.

Lettuce.

The successful seeding of lettuce in the valleys of southern Arizona is well known. For the past several years it has been produced commercially in both the Salt River and Yuma valleys. The Yuma Valley seems to be the most satisfactory area for seed production of this crop in that very little rain falls during the winter months. Occasional damp winters in the Salt River Valley are marked by heavy outbreaks of mildew which reduce seed yields.

Lettuce was not included in the regular seed production trials this year. However, plots of approximately one acre of new Arizona strains (University strains) of #152 and #615 were planted on the Yuma Valley Experimental Farm on November 10, 1941. The seed was harvested during the early part of June. The #152 yielded 330 pounds and the #615 strain yielded 413 pounds of recleaned seed per acre.

Endive

This crop was included in the trials again this year and was again found to be easily handled. Its behavior is similar to lettuce. A good crop of seed was produced.

II. HERB SEED PRODUCTION AND GROWTH*

Anise

Plantings made on October 9 at the Date Garden and on October 11 at the Mesa Farm grew vigorously throughout the fall and winter. Seed stalks were formed about March 1 and the plantings were uniformly in bloom by April 15. Late frosts did not injure the flower buds seriously. The seed matured very uniformly and could easily have been harvested by machine methods.

Yields of seed are shown in Table 4. The seed of Bulgarian Anise was obtained from McKessons and Spanish anise from S.B. Penick Company. Both were supplied by the Division of Drug and Related Plants. The Arizona seed was produced in the trials reported a year ago.

*The 1941-42 trials with herbs were in part financed by the Division of Drug and Related Plants of the United States Department of Agriculture. This report covers the cooperative trials.

Table 4.--Anise Seed Yields in Pounds per Acre. October 9 Planting was at the Date Garden. All Others on Mesa Farm.

Planting date	Harvest date	Strain		
		Bulgarian	Spanish	Arizona
Oct. 9, 1941	May 22, 1942	---	---	732
Oct. 11,	May 18	723	582	---
Nov. 11	May 25	808	847	---
Jan. 6, 1942	June 20	200	290	---
Jan.29	July 1	120	135	---
Mar. 18	July 20	50	40	---
May 15	Failure	---	---	---

Bulgarian anise yielded 141 pounds per acre more than Spanish anise for the October plantings.

The plantings made on November 11 yielded an average of 176 pounds per acre more than the October planting. However, the plants of the later planting were weak and tended to lodge prior to harvest. All plantings later than November 11 gave yields too low for commercial consideration.

It was observed that the Spanish type of anise ripened seeds one week to 10 days earlier than the Bulgarian type when planted later than November 11, but matured with the Bulgarian when planted in October or November. The Spanish type of anise tended to lodge more readily than the Bulgarian.

Anise planted October 3 on the sandy soils of the Yuma mesa grew slowly and blossomed sparsely. Large amounts of organic matter and frequent irrigation are needed for anise to produce well in this area. The fact that it blossomed at all indicates that it is a crop requiring little chilling and appears to be well suited in the warm valleys.

Coriander

Plantings made October 9 at the Date Garden and October 11 at the Mesa Farm grew rapidly and vigorously. By the end of January most plants were in full bloom. Frosts in February and March damaged some blossom heads, but the exact extent of damage to the final yield was difficult to determine. In the light of the 4,000-pound-per-acre yield obtained in 1941, the damage was possibly considerable. Yields obtained in the present trials are shown in Table 5. Two strains of Morocco coriander were supplied by the Division of Drug and Related Plants. The Arizona strain was from seed produced in trials of a year ago.

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Table 5.--Coriander Seed Yields in Pounds Per Acre. October 9 Planting at Date Garden, All Others on Mesa Farm.

Planting date	Harvest date	Strain		
		Morocco SBP	Morocco McK	Arizona
October 3, 1941	May 18, 1942	---	---	506
October 9	May 22	---	---	1,313
October 11	May 18	961	591	-----
November 11	May 20	760	700	-----
January 6, 1942		Failure	Failure	
January 29	June 1	232	77	110
March 18	June 25	207	348	-----
May 15		Failure	Failure	

SBP - from S. B. Penick Co.
McK - from McKessons Co.

Plantings made on November 11 yielded nearly as well as those on October 11, even though frost damaged many of the flower heads in the November 11 planting. Plantings later than November 11 resulted in a reduced yield, bacause of the tendency for the crop to bloom before the plant attained vegetative maturity. A mid-summer planting maturing by November 15 might be desirable.

Coriander does not mature uniformly and shatters readily. These conditions prevent the use of machinery in harvesting, unless the crop is cut green. When this is done some of the seed would be light.

The plants of all strains were highly variable. Selections were made for early and uniformly maturing types, and for resistance to frost.

Coriander planted on the Yuma mesa October 3 grew vigorously throughout the winter, probably due to the high minimum temperatures. The yield was average (506 pounds per acre). Large quantities of water were needed on this sandy soil.

Coriander appears to be a promising crop for the warm valleys of southern Arizona, although yields were not as satisfactory this year as last. More trials will be necessary to determine the best elevation and planting date.

Fennel

One sample of Roumanian and two samples of Indian fennel were tested. All were supplied by the Division of Drug and Related Plants.

Fennel is a slower growing crop than anise or coriander. It is normally a perennial but in the lower irrigated valleys of Arizona it is necessary to treat it as an annual since it does not recover readily after the plant has been cut for seed in the early summer.

The Roumanian fennel planted October 12 did not blossom until June. Therefore, seed formation extended into midsummer and all seeds were either empty or shriveled. This type of fennel does not seem to offer promise for commercial production in southern Arizona.

The two samples of Indian fennel planted in mid-October grew rapidly and were in bloom by February 9. Frosts during February and March killed back the central seed stalk but within a few weeks side shoots were up and by mid-April the plots were in full bloom. The McKesson strain recovered more rapidly than the S. B. Penick strain.

All plantings later than November 11 blossomed in June and July and produced shrunken non-viable seed. The May 15th planting failed to germinate. Fennel yields are shown in Table 6.

Table 6.--Fennel Seed Yields in Pounds Per Acre. October 9 Planting at Date Garden. All Others at Mesa Farm.

		Strain		
Planting date	Harvest date	Indian SBP	Indian McK	Roumanian SBP
Oct. 9, 1941	June 15, 1942	1,700	1,748	---
Oct. 11	June 8	1,088	1,961	---
Nov. 11,	June 25	1,188	1,922	---
Jan. 6, 1942	Blossomed too late - shriveled seed not harvested.			
Jan. 29	" " "	"	" "	"
Mar. 18	" " "	"	" "	"
May 15	Failure			

Caraway

The trials this year were with Russian caraway from the S. B. Penick Company and supplied by the Division of Drug and Related Plants.

Caraway is a biennial apparently having a definite chilling requirement which is not satisfied in the Salt River Valley. This might be offset to some extent by earlier plantings. The October plantings made this year did not permit of vegetative maturity before frosts and cool weather stopped growth. Seed stalk formation in April was irregular and blossom heads were sparse. Nevertheless the October 9 planting at the Date Garden yielded 205 pounds of seed per acre and the October 11 planting at the Mesa Farm yielded 174 pounds. All seed was harvested in June.

Plantings of caraway made after October 11 did not form seed stalks in the spring and the rosettes died in the heat of late June and July.

Caraway seeds are used in the baking and confection trades. Extracted oil is used in perfumes and soaps. It is one of the herb crops of which supplies are most limited at the present time. Evidence from trials thus far indicates that in the mid-elevations of Arizona it would produce well. Earlier plantings in the Salt River Valley might give higher yields.

French celery

Plants from the October 11 planting at the Mesa Farm grew rapidly through the fall and continued to develop through the winter. By April 15 all plants had produced seed stalks, 50 per cent of which were in bloom. The seed was ready for

harvest by June 15. Ripening was reasonably uniform and shattering was slight. An average of 616 pounds of seed per acre was harvested.

Plantings after October 11 failed. It was evident that this crop is a true bienniel requiring a chilling period after completion of its vegetative growth before seed will be produced. The indications are that an August or September planting would be more successful.

The seed used in these trials was from the S. B. Penick Company and supplied by the Division of Drug and Related Plants.

Dill

Using seed produced in the previous years trials, this crop was planted on the Yuma mesa on October 3, 1941 and at the Date Garden on October 9. On the Yuma mesa it grew to a height of 3 to 4 feet, whereas on the Date Garden it reached a height of 7-8 feet.

Seed were harvested on the Yuma mesa April 18. A yield of 1,914 pounds per acre was obtained. At the Date Garden seed were harvested June 8 and a yield of 4,089 pounds per acre was obtained.

Dill stands both heat and cold quite well and requires no chilling to produce seed. It is ideally adapted as a winter crop in southern Arizona. Yield of seed in the experimental plots for two years have been several times as great as those generally reported. However, dill is readily grown in many parts of the United States and a study of market demands should be made before entering into commercial production.

Sage

Sage is a perennial crop. Plantings established from root division and seed in the fall of 1940 flowered profusely in April 1942. An average of 326 pounds per acre of well-filled viable seed was harvested May 29, 1942. After the seed was harvested the plants died.

This experience has suggested that in the Salt River Valley sage may be carried over during one summer to produce a seed crop the second spring. However, it appears that sage is short lived in the warmer districts and yields of both leaves and seed are probably not as great as in higher elevations. Sage is now being produced commercially by one grower in the San Simon area.

At the present time supplies of sage leaves for food seasoning are very low and prices are satisfactory. However, sage leaves can be produced over wide areas of the United States and it is doubtful if Arizona has any special advantage for leaf production.

Sweet Marjoram

Sweet marjoram planted in October 1940 produced 193 pounds per acre of viable seed in late July 1942. This is a perennial crop which grows vigorously throughout the year in southern Arizona. It seems to be naturally adapted, and yields large amounts of both leaf and seed.

Sweet Basil

This plant yields a condiment used especially in the preparation of tomato sauce. Seed planted March 18, 1942 was ready for leaf harvest in mid-June and for a seed harvest July 25. Although no yield records were taken, seed was abundant and viable.

Thyme

In the trials extending over two years in the Salt River Valley, thyme has been found to grow vigorously and seed profusely in early August of the second year after planting the seed. It has been observed to grow well in the Tucson area.

Chive

Chive has produced seed abundantly the second year after planting but 90 per cent of the seeds were not viable. Chive seed generally is of low viability.

Miscellaneous

Tapioca has been grown on the Yuma mesa for four years and thrives well. Thus far it has not been possible to reckon yields of starch. Tapioca is in demand as a food but more particularly as a source of mucilage and as a bonding agent. However, recent developments have indicated that a mucilage of equal value can be obtained from sweet potato starch, a product which can probably be produced much more cheaply than tapioca.

Seeds of Perilla, an oil-bearing plant of the mint family, were planted January 29, 1942. Germination was very poor and all of the seedlings appearing were frosted in March.

Licorice from seed obtained in Turkey has been established in the greenhouse at Tucson. Thus far, attempts to establish it in the Salt River Valley have failed.

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Bureau of Plant Industry Station
Beltsville, Md.
February 24, 1943

Dr. H. F. Babb, Cheyenne Horticultural Field Station, Cheyenne, Wyo.
Dr. W. C. Edmundson, Box 767, Greeley, Colo.
Dr. A. H. Finch, University of Arizona, Tucson, Ariz.
Mr. M. Shapovalov, Agricultural Experiment Station, Logan, Utah.
Dr. J. C. Walker, University of Wisconsin, Madison, Wisconsin.
Mr. F. N. Lombard, Beltsville, Md.

Dear Sirs:

Attached are tables showing the final germination results of the cooperative vegetable seed trials. These samples represent seed raised in different areas from a uniform shipment of roots obtained from a seed firm in New England and sent out to the various cooperators by the Bureau of Plant Industry. Photographs of representative germination tests, taken at the time of the preliminary germination count, are included to show the comparative rates of germination. The final germination (shown in the tables) may be much higher than indicated by the photographs.

In comparing seed quality from the different areas it should be noted that in some places harvesting was by individual plants and in others by date of flowering. The scanty results from Utah were due to the impossibility of finding a suitable plot before severe deterioration of the roots. In general, it is evident that beet and carrot require a fairly long season for good development of seed. Undoubtedly turnip might produce seed better with home grown roots.

Very truly yours,

E. H. Toole
Physiologist

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The germination of commercial samples of carrot seed grown in Utah, 1942

No.	Variety	Region	Germination
Ut 1	Red Cored Chantenay	Washington (Staheli)	81
Ut 2	Imperator	Cedar City (Esplins)	87
Ut 3	"	Hurricane (Graff)	85
Ut 4	[illegible]	Logan	55

The germination of beet seed, Long top Detroit red, from various cooperators. Roots supplied by B.P.I. were all from same stock.

Sample No.	Region	Cooperator	Tagged	Harvest	Yield grams Heavy seed	Germination %
Wy. 1	Wyo., Cheyenne	M. F. Babb	--	9-28-42	2550.	94
	Total number of plants harvested at Cheyenne = 31					
" 5	" Laramie	"	—	9-25-42	161.	48
	Total number of plants harvested at Laramie = 6					
" 2	" Torrington	"	—	8-19-42	144.	94
" 3	" "	"	—	9-3-42	2375.	91
" 4	" "	"		9-24-42	1005.	84
	Total number of plants harvested at Torrington = 29					
W. 1	Wisc., Jacksonport (From 6 more advanced plants. Ripening may have been hastened by extreme dry weather 8-10 to 8-20. Cercospora leaf blight 7-29 general but not serious)	J. C. Walker	--	8-27-42	650.6	73
W. 2	Wisc., Jacksonport, (From 6 less advanced plants)	J. C. Walker	--	9-14-42	79.3	61
W. 3	Wisc., Racine (13 roots planted. 9 plants harvested. Cercospora leaf blight 8-15 - little or no damage)	J. C. Walker	--	9-10-42	938.	48
Me. 1	Me. Presque Isle	P. M. Lombard**	--	Sept.? 42	70.5	*13
" 2	" "	"	—	"	183.	56
" 3	" "	"	—	"	31.	64
" 4	" "	"	—	"	99.1	*18
" 5	" "	"	--	"	20.	51
" 6	" "	"	—	"	54.8	6
" 7	" "	"	—	"	33.4	9
" 8	" "	"	—	"	66.2	*16
" 9	" "	"	—	"	221.3	54
" 10	" "	"	—	"	279.3	42
" 11	" "	"	—	"	90.0	11
" 12	" "	"	—	"	171.7	41
" 13	" "	"	—	"	167.7	4
L 1	Utah Logan	M. Shapovalov			Only one plant survived. Very undeveloped fruits. No germination; apparently no seed set.	

Germination of carrot seed, Greater Chantenay, from various regions. Roots furnished by B. P. I. were all from same source.

Sample No.	Region	Cooperator	Tagged	Harvest	Heavy seed (grams)	Germination of heavy seed
Wy. 1	Wyo., Cheyenne	M. F. Babb	7-15-42	9-22-42	44.5	98
" 2	" "	"	7-18-42	"	11.5	95
" 3	" "	"	7-30-42	"	8.7	93
" 4	" "	"	8-12-42	"	5.3	83
Total number of plants harvested at Cheyenne = 10						
" 6	" Torrington	"	7-2-42	8-19-42	8.0	97
" 8	" "	"	—	"	5.7	96
" 7	" "	"	7-22-42	9-21-42	1.1	98
" 9	" "	"	8-19-42	"	1.6	73
" 5	" "	"	—	"	314.0	93
Total number of plants harvested at Torrington = 3						
Wi. 1	Wisc., Jacksonport	J.C. Walker (1 plant)	—	9-14-42	10.0	94
" 2	" Racine	" (5 plants)	—	9-20-42	218.0	54
Me. 1	Me., Presque Isle	P. M. Lombard		Sept. 42	12.4	15

The germination of rutabaga seed from various cooperators.
Roots furnished by E. P. I. all from same source.

Sample number	Region	Cooperator	Tagged	Harvest	Threshed	Yield (grams) Heavy seed	Germination %
R-17	Wyo., Cheyenne	M. F. Babb	6-18	8-7	8-12	2.4	98
R-1	" "	"	---	"	"	17.6	96
R-14	" "	"	6-18	8-14	9-8	4.1	95
R-13	" "	"	7-3	"	"	1.8	95
R-12	" "	"	7-9	"	"	0.6	98
R-4	" "	"	---	"	"	37.5	98
R-16	" "	"	7-3	9-27	"	2.7	97
R-15	" "	"	7-9	"	"	1.6	98
R-3	" "	"	---	"	"	26.8	97
R-2	" "	"	---	9-26	---	27.4	61
Total number of plants harvested at Cheyenne - 6							
R-21	" Laramie	M. F. Babb	7-1	8-20	9-8	---	92
R-22	" "	"	7-7	8-20	9-8	2.4	88
R-23	" "	"	7-1	9-9	9-10	2.5	92
R-20	" "	"	7-7	"	"	2.3	82
R-19	" "	"	---	"	"	1.6	87
R-18	" "	"	---	9-25	---	7.5	5
Total number of plants harvested at Laramie - 3							
R-5	" Torrington	M. F. Babb	6-5	7-22	7-28	44.9	93
R-9	" "	"	6-17	"	"	11.0	89
R-25	" "	"	7-2	"	"	0.9	80
R-6	" "	"	---	"	"	17.7	92
R-10	" "	"	6-17	8-19	9-1	2.6	78
R-11	" "	"	7-2	"	"	(333 seed)	100
R-8	Wyo., Torrington	M. F. Babb	---	"	"	17.7	89
R-7	" "	"	---	9-24	---	17.4	84
Total number of plants harvested at Torrington - 7							
W-2	Wisc., Jacksonport	J. C. Walker	---	7-29	7-29	1.9	97
(Premature ripening of some branches)							
W-3	Wisc., Jacksonport	J. C. Walker	---		8-10 Main harvest	12.8	94
(8 roots planted. Root rot evident 6-1. Two plants survived and these had severely rotted roots and weak seed stalk development.)							
W-4	Wisc., Jacksonport,	J. C. W alker			8-29	5.9	93
(From a few pods at end of branches still green on 8-10)							
W-1	W isc., Racine	J. C. W alker		8-20 thru 8-27	---	149.6	97
(5 roots planted, 5 harvested.) Some aphid injury.							
U-1	Utah, Logan	M. Shapovalov				(200) (seed)	95
U-2	" "	"				(200) (seed)	94

The germination of turnip seed, Purple Top White Globe, from various cooperators. Roots supplied by B.P.I. were all from the same stock.

Sample number	Region	Cooperator	Tagged	Harvest	Yield grams (Heavy Seed)	Germination %
W 1	Wyo., Cheyenne	H. F. Babb	7-1	8-14	1.2	90
W 2	" "	"	—	9-28	10.8	71
	Total plants harvested at Cheyenne = 3					
R-24	" Laramie	"	—	7-29	0.7	90
	Total plants harvested at Laramie = 1					
W 5	" Torrington	"	6-5	7-22	6.9	96
W 6	" "		6-17	7-22	8.2	97
W 8	" "		—	7-22	8.5	97
W 3	" "		7-2	8-19	(100 seed)	89
W 7	" "		—	"	4.3	87
W 4	" "		1 plant uprooted	7-2	1.5	71
	Total plants harvested at Torrington = 4					
1	Wisc., Racine	J.C.Walker	50% fl. 6-1 General fl. 6-8	8-8	102.6	98
	Small seed sieved out of above sample				16.9	85
3	Me., Presque Isle	P.M.Lombard	Individual plants		37.6	97
7	" "	"	Date of harvest not		35.4	97
2	" "	"	given. Not tagged		35.9	92
6	" "	"	"		54.7	92
4	" "	"	"	Plant abnormal-diseased?	36.6	90
1	" "	"	"		—	89
8	" "	"	"		16.0	89
5	" "	"	"		55.4	79
9	" "	"	"			86
1	Utah, Logan	M.Shapovalov	—	—	—	80
2	" "	"	—	—	Small amt. undeveloped seed	70

* The final percentage of germination is the average of 4 duplicate tests. The photographs show the preliminary germination of one of these tests selected at random.

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UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING
DIVISION OF FRUIT AND VEGETABLE CROPS AND DISEASES

Beltsville, Md. July, 1944

COOPERATIVE TRIALS OF NEW AREAS FOR VEGETABLE SEED PRODUCTION IN 1943

Contents

INTRODUCTION

By E. H. Toole
Bureau of Plant Industry, Soils, and Agricultural Engineering

The greatly increased demand for vegetable seeds grown in the United States made it desirable to obtain more definite information as to the possibilities for seed production of biennial vegetables in areas not now utilized for commercial production. In the spring of 1942 the Bureau of Plant Industry, Soils, and Agricultural Engineering greatly expanded its vegetable seed work. As one phase of this development cooperative arrangements were made with several State agricultural experiment stations for cooperative trials of new areas for seed production of beet, carrot, turnip, onion, and cabbage. Some of these experiment stations had previously started local projects on seed production. The purpose of these trials has been to learn the response of these biennial seed crops in many areas of the Pacific and Mountain States, and the general method of culture that might be best adapted to the area. Plantings were arranged in as many areas as was possible in order to test the influence of the great range of altitude, soil and climate in these States. This wide distribution of plots made close supervision impossible and local labor shortages prevented adequate care of some plantings so that low yield records may not necessarily indicate the unsuitability of an area.

It is recognized that acre yields, calculated from small plots such as were used in these trials, do not reveal the commercial yields to be expected, but they should give a general indication of the possibilities of commercial production. Although these trials as yet include results for only one year, they should serve to indicate, to those interested in expanding the production of vegetable seeds, those areas that are most promising for commercial trials. The detailed records of plant development, yield, and seed quality and general observations of each planting have been prepared for each of the four regions by those who directly supervised the work. Additional plantings, planned to utilize the experience gained this first year, will be harvested in 1944 with results that will add to the information given here.

Supplementing these trials of promising new areas of seed production, cooperative agreements have been made between the Bureau of Plant Industry, Soils, and Agricultural Engineering and State experiment stations and other agencies in Idaho, Washington, and Oregon, resulting in the starting of extensive experiments on pressing problems related to cultural practices and disease control of seed crops of cabbage, carrot, onion, and table beet. The results of these experiments will be made public as they become available.

VEGETABLE SEED PRODUCTION TRIALS IN WYOMING, COLORADO, AND NEBRASKA

By G. B. Brown and M. F. Babb
Bureau of Plant Industry, Soils, and Agricultural Engineering

To test the seed producing possibilities in certain areas of the Central Great Plains and Rocky Mountain regions, test plantings were made in widely separated localities in Colorado, Wyoming, and Nebraska.

Arrangements in Colorado were made by Prof. A. M. Binkley of Colorado State College for plantings at Grand Junction, Olathe, Cortez, Ft. Lewis, and Monte Vista. Plantings at the Colorado Potato Experiment Station at Greeley were made by Mr. W. C. Edmundson of the Bureau of Plant Industry, Soils, and Agricultural Engineering.

Dr. H. O. Werner of the University of Nebraska arranged for tests in Nebraska on State Experiment Farms at Alliance, Scottsbluff, North Platte, and also at Lincoln.

In Wyoming, plantings were made on private farms at Sheridan, Cody, Worland, and Wheatland. At Torrington, the tests were made at the State Experiment Station with the cooperation of Dean J. A. Hill and Mr. W. L. Quayle of the University of Wyoming.

In some localities, the plots did not have adequate cultivation and water, due to a shortage of labor, while the great distances between plantings caused difficulties in keeping records and in direct supervision of the work. With the exception of Alliance, Nebraska, all plantings were on irrigated land.

Roots used in the tests were grown at the Cheyenne Horticultural Field Station in 1943 and stored in sand in a root cellar. Varieties used were: carrot - Red Cored Chantenay; beet - Detroit Dark Red; turnip - Early White Flat Dutch; rutabaga - Early Neckless; and parsnip - Short Thick.

When removed from the sand, the roots were sorted to eliminate those that were injured or rotted. Carrots were sorted to eliminate the small roots (under 1¼" diameter), while the roots of the other crops were used regardless of size. Sufficient roots were measured and weighed to obtain the average size and weight of individual roots.

Very few of the parsnip roots started growth or produced seed. This was probably due to injury in topping or to improper storage conditions. A few plants produced seed stalks, but the seed was chaffy and apparently not viable. No parsnip seed was harvested from any of the plantings.

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Turnip roots were planted at Cheyenne, Torrington, Wheatland, Cody, Sheridan, Worland, Scottsbluff, Alliance, North Platte, Lincoln, and Greeley; rutabagas at Cheyenne, Torrington, Scottsbluff, North Platte, Alliance, and Greeley. With the exception of Greeley, the plantings were failures, due to late planting and long standing of the roots after removal from storage. At Greeley, the roots were set March 30 and produced satisfactory results. Harvests were made of all plantings that survived, but yields were negligible.

Unless otherwise shown in the following paragraphs, harvests were made by pulling entire plants and allowing the plant to dry before threshing. In other cases, the seed was harvested as it ripened.

The general development of the seed plots at the various stations is given in table 1, and table 2 shows yields and results of germination tests of carrot and beet seed. The yields per acre are calculated on the basis of the yield of the plants surviving until harvest and the total area planted. By such a method of calculation a plot may show a very high yield per plant and still a low yield per acre.

Some observations made on the individual plantings follow:

Cheyenne, Wyo.: Carrots were sorted into 3 sizes; small, under 1" diameter; medium, 1" to 1½" diameter; and large, over 1½" diameter. Plants from the small roots appeared to be a few days later in development than those from the large, and had less vegetative growth. Although a greater number of the small roots survived to harvest, the amount of seed per plant was about one-half that from the large or medium roots. Rabbit injury and late transplanting contributed to a poor yield. Beets did not show much promise. Rabbits injured some roots before growth started, and the plants that reached maturity gave a poor yield with poor germination. The reason for this is unknown, as beet seed has been grown with fair success at this station. Poor roots apparently are not the cause, as identical roots gave excellent yields at the other stations.

It is generally conceded that the growing season is too short at this station for successful commercial production of most vegetable seeds.

Torrington, Wyo.: Cold weather followed planting, and weeds were not controlled due to a shortage of labor. Some carrots suffered root rot, but most developed into well branched plants, giving a good yield of seed with 96% germination. Root rot affected the beets seriously, as did weed competition. Vegetative growth was poor, and a large number of seeds were black and shrunken at harvest time. Further trials should be made in this territory, although commercial beet seed production might be influenced by the prevalence of sugar beet culture.

Wheatland, Wyo.: With the exception of the turnip, the yields and germination were excellent, although the plot was located on rather wet land. The crop had excellent care throughout the season. This would appear to be a good territory for carrot seed production. The growing of sugar beets here might limit table beet seed raising.

TABLE 1--General development of carrot and beet plants grown for seed in 1943

Station	Elevation	Date roots planted	No. planted	Date of full flower	Height at full flower	Branches flowering	Estimated seed set 1st order branches	Estimated seed set 2nd order branches	Estimated seed set 3rd order branches
	Feet				Inches	No.	Percent		
CARROT									
Cheyenne	6200								
Large root		5/19	133	7/20	26	14	80	80	30
Medium root		5/19	133	7/26	25	14	80	80	30
Small root		5/19	133	7/30	20	6	80	80	30
Torrington	4098	5/11	133	7/20	30	13	85	85	40
Wheatland	4747	6/6	133	7/20	30	10	85	75	45
Cody	5018	5/26	133	7/20	30	10	85	75	45
Sheridan	3724	5/16	133	7/8	36	10	90	80	25
Worland	4061	5/4	133	7/20	20	15	75	75	40
Scottsbluff	3880	5/20	133	7/23	25	11	85	80	50
Alliance	3971	5/20	133	7/15	17	8	60	45	20
North Platte	2821	5/10	160	7/1	30	--	89	--	--
Lincoln	1189	--	---	--	--	--	--	--	--
Grand Junction	4583	5/1	704	7/7	30	11	80	75	75
Olathe	5000	5/10	522	7/9	26	12	80	70	40
Cortez	6198	5/10	950	7/15	25	9	90	80	70
Ft. Lewis	7600	5/5	600	7/17	42	10	90	85	Bloom
Monte Vista	7500	5/24	300	7/15	29	10	75	75	Bloom
Greeley	4600	3/30	250	6/30	35	8	50	50	50
BEET									
Cheyenne		5/19	100	7/26	16	12	40	--	--
Torrington		5/11	117	7/26	19	10	40	--	--
Wheatland		5/6	100	7/26	29	14	80	--	--
Cody		5/26	110	7/30	24	14	90	--	--
Worland		5/4	100	7/20	20	8	70-80	--	--
Scottsbluff		5/20	75	7/27	20	10	50	--	--
Alliance		5/20	100	--	--	--	--	--	--
North Platte		5/10	100	--	--	--	--	--	--
Lincoln		--	---	--	--	--	--	--	--
Ft. Lewis		5/5	250	7/17	27	7	90	--	--
Monte Vista		5/24	200	7/20	12	7	--	--	--
Greeley		3/30	250	6/20	40	10	85	90	--

TABLE 2--Yield and germination of carrot and beet seed grown in 1943

Station	Elevation	Date harvested	Survival at harvest	Average yield per plant harvested	Calculated[1] yield per acre	Percent germination
	Feet		Percent	Grams	Pounds	
CARROT						
Cheyenne	6200					
Large root		9/13	49	37	334	77
Medium root		9/13	58	31	332	81
Small root		9/13	73	19	235	72
Torrington	4098	8/30	83	50	746	96
Wheatland	4747	9/10	92	58	967	94
Cody	5018	10/5	95	36	600	88
Sheridan	3724	8/29-10/1	92	35	664	82
Worland	4061	9/15	90	40	648	88
Scottsbluff	3880	8/30	75	36	549	92
Alliance	3971	9/11	30	17	101	82
North Platte	2821	9/4	89	--	---	84
Lincoln	1189	--	--	--	---	80
Grand Junction	4583	8/23	71	50	650	77
Olathe	5000	8/23-9/24	77	23	328	90
Cortez	6198	9/24	53	32	331	80
Ft. Lewis	7600	9/25	93	20	880	88
Monte Vista	7600	9/23	33	91	555	87
Greeley	4600	8/13-8/24	46	60	602	89
BEET						
Cheyenne		9/13	55	25	179	57
Torrington		8/30	61	29	305	74
Wheatland		8/26	81	171	2845	77
Cody		10/5	66	239	3125	78
Worland		8/28	70	94	1224	52
Scottsbluff		8/30	53	23	234	87
Alliance		---	0	--	---	--
North Platte		---	-0	--	---	--
Lincoln		---	2	--	---	78
Ft. Lewis		9/16	66	27	785	77
Monte Vista		---	9	0	---	--
Greeley		8/24	81	142	2448	60

1/ Calculated from actual yield from area planted.

Cody, Wyo.: This planting was made very late (May 26). The yields of beet and carrot seed were very good, although the plants were slow maturing. The plot had regular cultivation and irrigation, and the carrots and beets developed into large, well-branched plants. Seed on the beet plants was sufficiently heavy to bend and break a number of stalks. The seed was harvested very late, and was ripe enough to cause an estimated 20% loss from shattering. This was no doubt compensated for by a larger amount of mature seed than would have been present at an earlier harvest date. All the turnips died of root rot.

In view of the excellent yields, and the fact that some vegetable seed is grown commercially, it appears that carrot seed production would be a success in this territory. As in numerous other places in the mountain and plains region, sugar beet culture might interfere with table beet seed production.

Sheridan, Wyo.: Although lack of water perhaps held down the yield to some extent (the plot had only one irrigation) and high winds broke a number of plants, vegetative growth was fair and the carrot seed harvested was average in yield and germination. The seed was harvested as it ripened. The turnips yielded only 1 pound of seed from 100 plants, for reasons previously mentioned.

Carrot seed production appears to be feasible at Sheridan, although need for further experimental work is indicated. Beets were not planted at this station because of the large number of sugar beets grown.

Worland, Wyo.; Vegetative growth was good on all crops in spite of weed competition. The plot was irrigated every ten days, but not cultivated sufficiently to keep down the weeds. Some roots suffered decay, although not enough to cut down the yield appreciably. The carrot seed was harvested as the umbels ripened. The turnips failed to produce a satisfactory crop of seed because of root rot. As at Sheridan, sugar beets might interfere with table beet seed production. Further experimental work should be done on carrot seed production.

Scottsbluff, Nebr.: Late planting (May 20) due to weather conditions cut down the yield of all crops, as did the poor soil in which the plantings were made. Beet and rutabaga were planted in a farmyard and suffered damage from livestock and lack of water. The yield of carrot and beet seed was below the average, but the percent germination was high. Vegetative growth was poor on all crops, and roots of turnip and rutabaga rotted badly.

Table beet seed should not be grown in this area because of sugar beet culture. The yield and germination of carrot seed would indicate that this crop merits further trials.

Alliance, Nebr.: Late planting (May 20) and dry land conditions caused very poor yields. Turnip and rutabaga rotted after starting growth. Vegetative growth was poor on all plants, and carrots suffered from weed competition. Rabbits also destroyed many roots. From the results obtained at this station, it appears that vegetable seed production is not feasible on dry land in this particular area.

North Platte, Nebr.: Plantings were made May 10 -- too late for this territory. Ordinarily, roots would be set from a month to six weeks earlier. An epidemic of false chinch bug destroyed beets, turnips, and rutabagas, although

carrots were not noticeably affected. This epidemic was unprecedented. Under conditions in central Nebraska a fair crop of seed can usually be raised if planting is early.

Lincoln, Nebr.: No records are available. It is presumed that carrot and beet were the only seed maturing, as others were not received.

Grand Junction, Colo.: Vegetative growth of carrot was good with well branched plants, and seed was set down to the 4th order umbels. The yield of seed was not as good as was expected from the general appearance of the crop. At the time of harvest, the main umbels were starting to shatter, the 2nd order umbels were ripe, the 3rd were starting to ripen, and the 4th were green. Perhaps if the harvest had been made at a later date, the yields would have been higher, as would the percentage germination. The crop had good care.

Some vegetable seed has been grown commercially in this region in the past, but further experimental work should be done.

Olathe, Colo.: Carrots were planted May 10 and showed prospects of a good yield. However, a hail storm as seeds were ripening injured a great many umbels. These injured heads were harvested earlier than they would have been otherwise, nd produced very little seed. Vegetative growth was good, and cultivation and rrigation adequate. Further trials in this area are desirable.

Cortez, Colo.: Carrot plantings at Cortez did not have a fair trial. Due to a labor shortage, the roots were planted late (May 10), many of the roots rotted, and only 53% survived to harvest. Weed competition was rather severe. As some carrot seed is being raised commercially in this community, it is believed that further trials should be made with both carrot and beet.

Ft. Lewis, Colo.: Carrots and beets at this station produced very satisfactory results. In spite of the high elevation (7600'), growth and seed set were excellent on both crops. Seed was rather late in maturing, but no killing frost occurred until after harvest. Good care and irrigation contributed to the success of this planting. Vegetable seed has been raised experimentally at Ft. Lewis and this fact, together with the high yields obtained this year, would indicate possibilities of commercial production.

Monte Vista, Colo.: Carrot and beet roots were planted rather late (May 24). due to weather conditions, and a heavy frost June 17 killed many plants. Many roots were starting to rot before planting. Carrots that survived gave a surprisingly large yield of seed per plant. Harvest was late, giving opportunity for more seed to mature, and extreme care was necessary to save shattering seed. Beet seed did not mature. Trials should be made again at this station, with roots set as early as possible.

Greeley, Colo.: The beneficial effects of early plantings (Mar. 30) made at this Station are reflected in the yields of beet, turnip, and rutabaga seed. Carrots were injured by grasshoppers and wind. All seeds were harvested as they matured. This method of harvesting may have resulted in slightly higher yields than would have been the case had the whole plants been harvested. Carrot seed s grown commercially in the Greeley region, and further experimental work should nclude spacing, and perhaps date-of-planting experiments. Sugar beet growing is prevalent in this area.

GENERAL DISCUSSION

Generally, late harvests gave larger seed yields in spite of loss from shattering. Earlier plantings gave best results, although the Cody planting was an exception to this. This could have been due to the standing of roots after removal from storage, as all roots were removed at the same time, and those planted late had more opportunity to deteriorate. Without exception this was true of the turnip and rutabaga, while carrots were not noticeably affected.

Differences in results between localities are no doubt due as much to cultural practices and dates of plantings, as to soil and climate. If results are to be comparable, methods should be standardized as much as possible. It is realized that this is rather difficult due to distances from the base of operations.

In Wyoming particularly, there is always danger of damage to plants from wind. Deeper planting of roots might alleviate this trouble. Damage from hail is also a hazard in seed production, but not seriously greater than for other crops which are raised successfully.

From the results of this year's experiments, it is apparent that carrot seed can be raised successfully in most of this region. The high altitude at Ft. Lewis and Monte Vista might cause too short a growing season, as is the case at Cheyenne.

All stations in Wyoming are promising, and more experimental work should be done.

Greeley, Grand Junction, Olathe, and Cortez are the best regions studied in Colorado.

Sugar beet culture might limit table beet seed production at all stations in Wyoming, and at Greeley, Grand Junction, and Olathe in Colorado. Scottsbluff and North Platte, Nebraska, have the same limitations.

VEGETABLE SEED PRODUCTION TRIALS IN UTAH

By M. Shapovalov, Bureau of Plant Industry, Soils, and Agricultural Engineering, and L. H. Pollard, Utah Agricultural Experiment Station.

General Outline of the Project

Trials with the production of certain vegetable seed in Utah were started in the summer of 1942, by the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering in cooperation with the Utah Agricultural Experiment Station.

The main lines planned for study in these experiments were as follows:

Regional tests: Representative sections of the State were to be studied as to their suitability for growing certain kinds of vegetable seeds, particularly with reference to the length of the growing season and the characteristics of the

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winter period, such as the dependability of the snow coverage, occurrence of severe freezes, etc. In this connection the percentage of winter-kill was to be determined.

Methods of root handling: Data were to be obtained on the relative advantages and disadvantages of leaving the roots to overwinter in the ground in comparison with digging, storing, and replanting the following spring. In other words the so-called "seed to seed" method was to be compared with the "roots to seed" method.

Dates of seed drilling: In the sections with relatively short growing seasons seed to seed production may be advantageous only if the seed could be drilled after some other crop is harvested, i. e. if using the ground two full seasons for one vegetable seed crop could be avoided. Information was needed as to the suitability of small vegetable roots for economic seed production. Three sowings were planned for each vegetable, but because of the late start of the 1942 trials and difficulties in finding suitable farmer-cooperators, the first year's sowings were not as complete as was desirable.

Spacing tests: If precise spacing should prove unnecessary in the "seed to seed" production, much labor could be saved.

Winter protection of the roots remaining in the ground with some form of mulch.

Fall vs. spring planting of roots: If roots could be replanted in the fall, expense and labor required in storing these roots could be eliminated. An earlier and a later fall planting, i. e., with and without some after-planting growth, were to be compared.

Kinds of vegetables: To begin with it was decided to test seed production of carrot (Red Cored Chantenay), table beet (Detroit Dark Red), and turnip (Purple Top White Globe).

Carrot Experiments

The first season's tests were established at: North Logan (Cache County), Farmington (Davis County), Cedar City (Iron County), Hanna (Duchesne County), Washington (Washington County), Richfield (Sevier County). There was one planting each at Richfield and Hanna, and two each at North Logan, Farmington, Cedar City, and Washington.

This geographic distribution of the plots permitted observation of the effects of very diverse climatic conditions -- warm and long growing seasons in southern Utah, short, cold seasons at Hanna, and intermediate elsewhere; also, the effects of early and heavy snow blankets as at Hanna, as well as those of below zero weather appearing before any snow cover.

All plants in certain sections of these fields were counted during the latter part of September and then in the middle of April. The average percentages of winter killing thus determined were as follows.

North Logan, first sowing	89.2
North Logan, second "	65.9
Farmington, first "	40.3
" second "	29.5
Cedar City, first "	75.2
" " second "	No stand
Richfield	72.5
Washington	0.
Hanna	0.

The above data show the tremendous importance of the snow blanket. Under severe climatic conditions of Hanna, carrot roots survived the winter 100 percent, just as they did in the mild climate of Washington, Utah. On the other hand, a fairly moderate winter at North Logan with but a few nights of below zero temperature, was very detrimental to the carrot roots because these low temperatures came when there was practically no snow on the ground.

Where two seedings were made, the earlier one was about the middle of July and the later during the first week in August. By the time growth stopped the earlier group had roots up to 1½ inches in diameter (averaging about 3/4 inch) and the later not over 1 inch in diameter (averaging about ½ inch). In all cases, later sowings showed greater winter-surviving ability.

Only one planting of roots was made in the fall of 1942, near the end of October. Small roots from the experimental plots as well as large commercial roots were used for this purpose. Plantings were made at all stations except Hanna and Washington. Cold weather immediately followed planting, practically eliminating any possibility of plant growth in the fall. These fall root plantings were damaged much more severely than undisturbed seedling roots. None of the fall-planted large commercial and about 1 percent of the small roots at North Logan survived. The survival at Richfield was 18 percent. Conditions at Richfield were approximately like those at Farmington. Root plantings at Cedar City were badly damaged by rodents and determination of winter killing was not possible. The same kind of roots were planted at the same points in the spring and the mortality was slight except at Cedar City where the roots again were badly damaged by wild animals.

Only soil mulch was attempted in the fall of 1942 for the protection of seedling roots remaining in the field over winter. This was done by hoeing 3 to 4 inches of soil over certain undisturbed rows during the last week in October. This seemed to hasten the decay of the roots and the mortality in the mulched rows averaged higher than in check rows as shown in table 1.

Table 1. Comparative winter killing of soil-covered and undisturbed rows.

Place	Winter killing	
	Undisturbed	Soil-covered
	Percent	Percent
North Logan	89.2	95.4
Farmington	29.5	88.5
Cedar City	75.0	83.3
Richfield	72.5	83.9

TABLE 2--Yield and quality of carrot seed from experimental plantings in Utah

Location and treatment	Date planted	Number plants harv'ed	Yield per plant	Linear feet of row harv'ed	Cal'd: yield per acre	Purity of seed	Germ. of pure seed
			Ounces		Pounds	Pct.	Pct.
Logan							
Seed to seed:							
Unspaced	7-15-42	87	0.95	40	1867	95.5	93
Tall spaced,12"	"	12	1.33	--	-----	96.6	92
Soil mulch	"	35	1.73	--	-----	96.7	96
Unspaced	8-4-42	390	0.42	100	1496	95.9	93
Spring spaced, 6"	"	180	0.91	90	1654	92.0	93
" " ,12"	"	80	1.80	80	1634	97.6	96
Root to seed:							
Large roots	Mar. '43	165	1.48	165	1342	91.2	92
Small roots	" "	208	0.98	208	894	89.2	90
Commercial roots	" "	102	1.41	102	1280	89.0	91
Farmington							
Seed to seed:							
Unspaced	7-13-42	35	2.40	--	----	79.9	92
" 1/	"	408	0.53	160	2199	95.8	88
Spring spaced,12"1/	"	160	.73	160	1188	92.9	92
Root to seed:							
Young roots	Mar.1943	165	1.40	--	----	86.0	88
Commercial roots	"	18	1.25	--	----	92.7	94
Richfield							
Seed to seed:							
Unspaced	7-29-42	8	1.96	--	----	93.6	95
Root to seed:							
Young roots	3-23-43	16	2.08	20	1508	93.6	95
Commercial roots	"	13	2.26	20	1333	87.4	92
Washington							
Seed to seed:							
1st sowing	8-31-42	No yield record.				83.9	89
2nd "	9-12-42	" " "				83.3	91

1/ Rows 20 inches apart; all others 36 inches

With the high mortality of some sowings, resulting in irregular stands, it was not always possible to obtain comparable yield data. The results from harvests of representative sections are given in table 2. Where stands were satisfactory, the yields indicated the possibility of satisfactory commercial production. Seed quality was generally very high.

The Hanna plot was located approximately 7 miles north to northwest of Hanna on the east side of the Duchesne River, at an elevation of about 7,000 feet. The plot was established in cooperation with a local farmer, Mr. Joseph Wilcken, through the Duchesne County Agent, Mr. Broadbent. The growing season in this locality is very short, but the snow blanket is heavy and comes early. The only sowing of carrot seed was made toward the end of July. The roots were not more than pencil size when they were counted late in the fall.

There was no winter killing in this field. However, the plots were worthless as far as the seed production is concerned. On August 7, 1943, only 25 percent were bolting, of which only 6 percent were flowering and none had formed seed. A month later a few additional plants began to form seed but none ripened. The plot was left to overwinter for another season and a number of non-bolting roots were dug and replanted at North Logan.

Turnip Experiments

Fall seedings of turnips were made at Cedar City and Farmington but a very severe winter killed all sowings at Cedar City. There were three sowings at Farmington, July 13, July 27, and August 6. As in the case of carrots, the youngest plants survived best, the average survival being: First sowing, 48.3%; second sowing, 37.7%; and the third, 63.0%. The greater comparative damage in the second group was most likely due to the fact that the stand was very poor and the roots reached a large size before going into the winter.

The stand of the third sowing was the densest and presented good material for spacing trials. Plants in 50-foot sections of both rows were thinned to 12 inches apart. The yield was 50 percent greater for the section that was not thinned. The germination of the seed varied from 94 to 98 percent.

Beet experiments

Beets were fall seeded at Cedar City, Kanab, Glendale, and Richfield. The Cedar City plots were destroyed by the severe winter. Because of inadequate care the plots furnished no yield data but samples for germination were taken. See table 3.

Table 3. Germination of beet seed grown in Utah in 1943

Location and treatment	Germination (percent of balls giving one or more sprouts)
Kanab:	
Fall planted roots	89
Spring planted roots	57
Richfield:	
Seed to seed	69
Glendale:	
Seed to seed, 1st sowing	98
" " " 2nd sowing	97

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Conclusions

The first season's results give some rather definite indications in regard to possibilities with vegetable seed production in Utah.

(1) "Seed to seed" seems to be by far the simplest and most economical method of producing carrot, beet, and turnip seed.

(2) Later sowings, between August 1 and 15, not only gave yields equal to those from earlier sowings but were more resistant to cold. Later sowing also permits growing of some early crop on the same piece of land, thus lowering cost of production.

(3) Where severe frosts may be expected before snowfall, a very dense seeding (12-15 plants per foot) is desirable.

(4) Spring thinning to 12 inches between the plants greatly reduced the yield of turnip seed per acre and had a similar (though less striking) effect on carrot yields.

(5) Fall thinning, fall planting of roots, and plowing soil over the plants, under the conditions of the first year's trials, had detrimental effects on overwintering ability of the roots.

(6) Carrot seed was successfully produced in all parts of the State except the short-summer section near Hanna. Turnip seed was successfully produced at Farmington, but the plants were winter-killed under less favorable winter conditions at Cedar City. Beets were likewise killed at Cedar City, but grew satisfactorily both at Glendale and Richfield. Conditions at Kanab seem to favor even more bountiful growth of beet.

THE PRODUCTION OF VEGETABLE SEEDS IN ARIZONA

By A. E. Griffiths and A. H. Finch
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History of Trials

Preliminary trials of vegetable seed production in Arizona were made in 1939. Between 1940 and 1943 the seeding habits of some thirty types of vegetables and related plants have been studied. The trials for 1942-1943 are a cooperative effort by the Arizona Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering. Investigations have been centered in the Salt River Valley but have covered ten localities with elevations of 100 to 4,000 feet.

Yuma Valley
(Elevation 100 ft., 800 hours of chilling, 45° F. or below)

Of the vegetable seed crops, lettuce appears to succeed best. More than 50,000 pounds were produced in 1942-43. A crop planted at the usual time for seed production of a given strain can, by careful harvesting, yield a crop of heads and still produce a crop of seed from the stumps. Yields on the Yuma Valley Experiment Farm have been from 200 to 400 pounds of seed per acre.

Endive is an annual which seeds readily. Two hundred to three hundred pounds per acre have been harvested in commercial fields. Cantaloupe seed of excellent quality has been produced experimentally for several years. In 1943 a yield of 560 pounds per acre was obtained. Prompt harvest of the seed to prevent sprouting in the melons is necessary.

Salt River Valley
(Elevation 1100 ft., 1100 hrs. of chilling)

Studies on vegetable seed production have centered at the Salt River Valley Vegetable Research Farm. In general, two 1/100 acre plots of each variety were grown. A standard 40-inch bed with 2 rows 16 inches apart was used. All experience to date indicates that the crops best suited for seed production in this area are: Broccoli, table beet, carrot, lettuce, onion, cantaloupe, and cauliflower.

Beet. Data for the 1941-42 and 1942-43 experiments are shown in table 1.

Table 1. Data on table beet, Salt River Valley, 1941-42, 1942-43

Variety	Date planted	Date of mkt. maturity	Date of full bl.	Date of seed har.	Yield Per A.	Aver. Germ.
					lbs.	%
Crosby Egyptian	10/12/41	1/1/42	---	6/20/42	3374	---
	9/25/42	12/10/42	4/1/43	6/4/43	3092	80
Early Wonder	10/12/41	1/1/42	---	6/20/42	2843	---
	9/25/42	12/10/42	4/1/43	6/4/43	2976	82
Detroit Dark Red	10/12/41	1/15/42	---	6/20/42	2233	---
	9/25/42	12/20/42	4/9/43	6/4/42	1809	75
Sandreth Best	9/25/42	12/15/42	4/5/43	6/4/43	1652	86
Ohio Canner	9/25/42	12/20/42	4/9/43	6/4/43	836	75

It is evident that table beet seed can be grown satisfactorily on a "seed to seed" basis. No comparisons have been made between yields from "seed to seed" and "seed to root to seed" methods. It was found that the earliest maturing seed was of considerably better quality than that maturing later. Efforts should be made to mature seed as early as possible. If further studies reveal that the "seed to root to seed" method delays seed harvest, there would be a question as to the suitability of the Salt River Valley for seed production of this crop by such method.

Curly top is present throughout Arizona but has not caused appreciable damage where the crop is planted early in September in the Salt River Valley.

Red beets cross readily with mangels, sugar beets, and chard. Growing two or more of these crops in the same area may affect seed quality. Table beet seed production should not be undertaken in the Salt River Valley as long as sugar beet seed is being produced.

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Italian Green Sprouting Broccoli. Data for the 1941-42 and 1942-43 experiments are shown in table 2.

Table 2. Data on Italian Green Sprouting Broccoli, Salt River Valley, 1941-1942, 1942-1943

Variety	Method of planting*	Date planted	Date of mkt. maturity	Date of full blm.	Date of seed har.	Yield per A.	Aver. Germ.
						pounds	pct.
Early Green Cala-brese	Seeded	10/12/41	1/15/42	---	5/22/42	551	
	"	9/25/42	1/11/43	2/15/43	5/5/43	1675	99
	Trans-planted	11/15/41	1/20/42	---	5/22/42	919	
		10/16/42	1/15/43	2/20/43	5/5/43	1177	100
Italian Green Sprtg, Early	Seeded	10/12/41	1/15/42	---	5/22/42	553	
	"	9/25/42	1/11/43	2/10/43	5/5/43	1989	98
	Trans-planted	11/15/41	1/20/42	---	5/22/42	478	
		10/16/42	1/14/43	2/20/43	5/5/43	1920	96
Italian Green Sprtg, Inter-mediate	Seeded	10/12/41	1/23/42	---	5/22/42	404	
	"	9/25/42	1/25/43	2/25/43	5/5/43	1099	97
	Trans-planted	11/15/41	1/25/42	---	5/22/42	753	
		10/16/42	1/29/43	3/1/43	5/5/43	1070	95

*All seed was planted in the field on the dates indicated. "Transplanted" plants were taken from the seeded rows and planted in adjoining beds on dates indicated under "transplanted".

It is evident that broccoli seeds satisfactorily. Broccoli seed has been produced commercially for five years with yields as high as 900 pounds per acre. Broccoli flowers very early in the spring and is thus subject to damage from late frosts. This accounted for the reduced crop of 1941-42. Aphids are always a menace in production of broccoli for either the fresh market or seed. Thrips are suspected of causing damage to the flowers. False chinch bugs have caused damage in occasional seasons.

Carrot. Data for the 1942-43 studies are shown in table 3.

Table 3. Data on carrot, Salt River Valley, 1942-1943

Variety	Date planted	Date of mkt. maturity	Date of full blm.	Date of seed har.	Yield per A.	Aver. Germ.
					pounds	pct.
Imperator	9/25/42	1/1/43	6/1/43	7/25/43	1515	90
Nantes	9/25/42	1/10/43	6/5/43	8/1/43	1104	94

Imperator has been grown for seed in the Phoenix area for several years. The experimental yields are probably somewhat higher than average. Commercial yields of 600-800 lbs. per acre, should be possible.

The carrot requires approximately ten months to produce seed when grown as a seed to seed crop at the lower elevations. Seeding prior to September 1 does not appear to hasten the production of seed materially. However, planting should be made before October 1, so the root can be well grown before growth ceases with cool weather. This seems to give stronger bolting in the spring with larger flower heads. Bolting occurs in April with seed ready for harvest in July.

Cauliflower. Data for the 1942-43 studies are shown in table 4.

Table 4. Data on Cauliflower, Salt River Valley, 1942-43.

Variety	Date planted	Date of Mkt. maturity	Date of full blm.	Date of seed harv.	Yield per A.	Aver. Germ.
					pounds	pct.
Earliest Snowball	9/25/42	1/25/43	2/25/43	5/19/43	262	85
Super Snowball	9/25/42	2/5/43	3/1/43	5/28/43	167	90
Mission Special	9/25/42	2/20/43	3/25/43	6/4/43	62	85
November-December	9/25/42	2/15/43	3/8/43	5/28/43	608	90

Cauliflower is much more sensitive to temperature and soil fertility than are most of the cruciferous crops. Thus, seed production requires more careful handling. However, it has been produced commercially in the Salt River Valley for several years. The yield of 262 pounds per acre of Early Snowball is probably better than average for commercial production. A yield of 260 pounds was obtained in 1941. Late spring frosts sometimes damage the flowers. They caused a complete loss in the experimental plantings for harvest in 1942. The insect pests of broccoli also menace cauliflower.

Onion. Data on the 1942-43 onion seed production trials are shown in table 5.

Table 5. Data on onion, Salt River Valley, 1942-43

Variety	Date planted	Date of Mkt. maturity	Date of full blm.	Date of seed har.	Yield per A.	Aver. Germ.
					pounds	pct.
Crystal Wax	9/25/42	4/25/43	5/15/43	7/15/43	215	93
Utah Sweet Spanish	9/25/42	4/25/43	5/15/43	7/15/43	125	83
Colonial Early White	9/25/42	5/1/43	5/20/43	7/15/43	90	70
Red Creole	9/25/42	5/1/43	5/20/43	7/15/43	60	89
Southport White Globe	9/25/42	6/30/43	--	--	0	--

The Bermuda (Crystal Wax) and Sweet Spanish types of onion are standard varieties in the Southwest. Salt River Valley winter temperatures provide

sufficient chilling to cause these varieties to bolt when grown on a "seed to seed" basis. Lower-than-usual seed yields of these varieties this year are attributed to the late planting. When onions are to be grown on a "seed to seed" basis, an early planting must be made to allow time for the growth of the bulb. A small bulb does not have the food reserves necessary to produce a large flower cluster. Late planting also tends to give a later harvest, so that seeds mature during the hot weather which may cause light seed.

This is the first year that Southport White Globe and the two southern hot bulb types, Colonial Early White and Red Creole, have been tried. Seed production was not satisfactory from them.

Commercial yields of seed in the Salt River Valley in 1942-43 were as high as 400 pounds. The best results were from small bulbs or sets grown from December to July of the previous year and set in the field in November. Seed from those sets was harvested in late June.

Cabbage. The production of cabbage seed has been under observation and study in the Salt River Valley since 1939. Several experimental and commercial plantings have been made during the three-year period 1940-43. With the exception of occasional small plots, successful yields of seed have not been obtained. This is particularly true of standard varieties. Savoy varieties appear to require less chilling and have seeded reasonably well.

The failure of cabbage to produce seed well in the Salt River Valley appears to be caused by insufficient chilling during the winter months. Cabbage has one of the highest chilling requirements among biennial vegetable plants. Evidence indicates that unless the winter has some 1,400 hours at 45° F. or below, reproductive bolting will not take place in the spring. The Salt River Valley normally experiences less than 1,100 hours of chilling.

Miscellaneous vegetables. Commercial seed production of turnip, rutabaga, radish, mustard, and spinach would not seem to be profitable in the Salt River Valley. Swiss Chard has not produced seed satisfactorily as it appears to have about the same chilling requirements as cabbage. Although lettuce seed has been produced successfully, both experimentally and commercially, the lower rainfall in the Yuma Valley gives that area an advantage. Cantaloupe seed has been produced for many years in connection with a breeding program with yields of more than 300 pounds per acre. Endive, chicory, and salsify have seeded well in experimental plantings and have promise for commercial production.

Santa Cruz Valley near Tucson
(Elevation 2400 feet, 1200 to 1600 hrs. of chilling)

In the 1942-43 season small experimental trials on seed production of certain vegetables were made in the Tucson area. There was some commercial seed production. From all evidence the following performance for the various crops is indicated.

Cabbage. Cabbage of two varieties, Jersey Wakefield and Marion Market, planted August 3, and transplanted to the field on September 15 produced marketable heads that were removed in December and January. Axillary flower stalks made some growth during the cool weather, and by mid-March began to elongate rapidly,

[illegible] April 5. These plants continued to grow and set pods [illegible], seed ripened in early June. It had a germination of 87 percent. There was no record of yield, but it is thought a commercial crop was indicated. Bolting was more thorough [illegible] in time than in the Salt River [illegible], and some non-reproductive development occurred as the temperatures increased in May. Bolting and seed production appeared to be better where heads were cut and removed than where the heads were allowed to remain or were slashed. [illegible] could cause damage to flowers and developing seed. Aphids are [illegible] present and must be controlled. It is believed that thrips damage the [illegible].

Onion. Utah Sweet Spanish onions were planted September 5 and thinned at "pencil" size to a 4- or 5-inch spacing. Bulbing and flower-stalk formation took place in April and May. Full bloom occurred in late May and seed was harvested in late June and early July. No yield records were taken, but production was obviously of commercial proportions. Seed was of good quality.

A commercial field of onion grown for seed was under frequent observation. Satisfactory growth and bolting occurred. Failure to irrigate during the seed-setting period seriously reduced the yield of good seed.

Carrot. Imperator and Chantenay carrots were planted September 5. The roots were of market size by January and were thinned to 3 inches. The remaining roots started to form flower stalks in early April, were in full bloom in early May, and ready for seed harvest in late July. No yield records were kept but yields were obviously of commercial size.

Broccoli and Cauliflower. These crops were planted August 3 and transplanted September 15. They both produced some seed the following spring but bloomed so early that damage from spring frosts occurred. At present these crops do not appear promising, although on a location with suitable air drainage they would likely be satisfactory.

Observation of small experimental plots or commercial fields indicated promising possibilities of seed production of table beet, swiss chard, mangel, and salsify.

Safford Valley
(Elevation 3000 ft., 1500 hrs. of chilling)

It is believed that sufficient chilling occurs in this area to induce seed production of any of the vegetable crops. Information in 1942-43 was obtained chiefly through cooperative trials with Mr. John Carpenter, Thatcher.

Cabbage. Cabbage plants in the experimental trials were retarded and blossomed late. There was marked reversion of bolted flower stalks to vegetative growth. Results were not indicative of successful cabbage seed production, yet in a private garden, early cabbage seeded more satisfactorily. Seed produced had [illegible] to 98 percent germination.

Onion. Utah Sweet Spanish onion sown August 15 and September 29, bolted and produced seed. The August 15 planting was much superior to the September 29 planting. Seed produced was of good quality. No yield records were kept, but

It would obviously have been a satisfactory commercial yield. Germination of [illegible] to 97 percent was obtained.

Carrot. Chantenay carrots were planted the same dates as onion. Roots matured before cold weather killed most of the tops. Bolting began in early April, and was strongest and most uniform from the early planting. Flowers opened in May and seed was ready for harvest in late June and July. Yield was not measured, but was obviously of commercial proportions. Germination was from [illegible] to 98 percent.

Table beet. Perfected Detroit beet was sown the same dates as onion and carrot. Roots reached commercial maturity by mid-summer. Curly top was observed in March and continued to be severe. Bolting began in early April. It was strongest and most uniform on the early planting. Flowers opened in early May. Seed began to ripen in late May and was ready for harvest by late June and early July. The early planting produced large flower spikes and was apparently least damaged by curly top. A satisfactory commercial yield was obtained in spite of curly top. Germination of seed was from 76 to 95 percent. Considerable sugar beet seed is being produced in this Valley, making it undesirable to introduce table beet seed growing.

Turnip. Purple Top White Globe turnip planted on the same dates as onion produced marketable roots in late fall. Bolting began in late February. Full flowering occurred in late March and early April. Seed ripened in late April and early May. Aphid infestation was severe and destroyed most of the seed.

Sulfur Springs Valley, San Simon Valley, and Duncan Valley
(Elevation 3600 - 4200 feet; no record of hours of chilling)

Trials in these areas were similar to those conducted in the Safford Valley and were in cooperation with Mr. Frank Murphy at McNeal, Mr. J. L. Schad at San Simon, and Mr. E. L. Hancock at Duncan.

It was apparent that all of the crops under trial might have possibilities of succeeding commercially.

Cabbage tests, unfortunately, were not conclusive. Some growers report having produced cabbage seed in previous years. On the other hand, a virus disease affecting cabbage flowers may be serious. This was discovered by Dr. J. C. Walker, University of Wisconsin plant pathologist, on April 22, 1943. The disease is unidentified and may be related to curly top of beets or to aster yellows. Its seriousness is so far unevaluated. In some of these areas there may be danger of the outright freezing of cabbage during the winter months. This would be likely only where an early planting to produce an early fall crop of heads is made.

Onion has uniformly seeded well and its adaptation either for "seed to seed" or "seed to bulb to seed" production is attested to by many years of small commercial production in Duncan Valley and Sulfur Springs Valley. Yields of 400 to 600 pounds per acre are commonly reported. Seed of more than 90 percent germination was produced in all of the experimental plantings.

Beet seeded uniformly although curly top was present to a greater or less extent in all locations. Germination was from 55 to 86 percent.

Carrot sown in the early fall and carried over the winter in the field produced edible roots in the early winter. Tops were generally killed by frost, but flowering and uniform bolting occurred in the spring. Seed yields were obviously of commercial proportions. Seed produced at Duncan had only 58 percent germination, but that at McNeal and San Simon had 96 and 97 percent, respectively.

Summary of vegetable seed production possibilities in Arizona

From evidence gained thus far, it is evident that many kinds of vegetable seed can be produced successfully in Arizona. Those best adapted seem to be the hardy annuals and biennials, although certain tender crops, such as cantaloupes, also have possibility.

VEGETABLE SEED PRODUCTION TRIALS IN OREGON

By D. D. Hill and H. E. Finnell, Oregon Agricultural Experiment Station, and P. W. Miller, Bureau of Plant Industry, Soils, and Agricultural Engineering.

Experimental investigations on the methods of production, harvesting, and handling of vegetable crops for seed at the Oregon Agricultural Experiment Station is a recent research program. For many years the late Prof. G. R. Hyslop tried to get such work under way in Oregon, but it was not until late 1942 that funds were available so that this very important work could be started. The research project is a cooperative one between the Departments of Farm Crops and of Plant Pathology of the Oregon Agricultural Experiment Station, and the Division of Fruit and Vegetable Crops and Diseases of the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering. The objectives are to work out methods of growing, harvesting, and handling, and of disease prevention and control for the most economical production of certain commercial vegetable seed crops in Oregon. Initial precedence in the conduct of the studies is being given to carrot, beet, cabbage, onion, and spinach.

This work has been started on an experimental area of ten acres near Coquille, Coos County, Oregon, and additional trials are being conducted at the Experiment Station at Corvallis. At the Malheur Branch Experiment Station in eastern Oregon, a comprehensive experiment on carrot seed production is under way. Experimental trials in the production of beans for seed are being carried on at the Southern Oregon Branch Experiment Station.

In addition to plantings made in the summer of 1942 at Coquille, Langlois, and Corvallis, commercial plantings in western Oregon have been closely observed.

The following tentative conclusions are deduced from investigations carried out to date on the suitability of various areas in western Oregon for the production of the vegetable seeds mentioned above:

Cabbage. The better soil types in western Oregon will, with proper fertilization, successfully grow cabbage seed. In a normal western Oregon season, the plants will survive the winter out of doors in most localities west of the Cascade mountains. However, in an abnormally cold winter practically all varieties of cabbage, with the possible exception of the Savoy varieties, are subject to winter-killing in all localities in western Oregon except in a narrow zone along the Pacific Coast.

Carrot. While the better soil types in western Oregon will produce good yields of carrot seed, the presence of wild carrot (Daucus carota) in practically all localities west of the Cascade Mountains presents a serious problem in the development of a carrot seed industry in this region.

Beet. The better soil types in western Oregon will produce good yields of table beet seed. The climate in western Oregon with the exception of a narrow zone along the Pacific Coast appears to be suitable for the growth of table beet seed. However, the established sugar beet and mangel seed industries in western Oregon interfere with the production of table beet seed in this region. Attention will have to be given to proper isolation to prevent cross-pollination if table beet seed production is to become a successful enterprise in Oregon.

Onion. There are a number of soil types in western Oregon on which good yields of onion seeds can be produced. The largest yields are produced on peat land such as occurs in the Lake Labish district near Salem, Oregon, and the Lake Labato area, near Gaston, Oregon. However, the high price of such land, the prevalence of downy mildew in these low-lying areas, and an embargo on growing of onion seed in the Lake Labish area, where most such land in western Oregon is located, due to the possibility of the yellow dwarf disease spreading from seed onions to market onions, preclude the use of much of this kind of land for seed growing. Instead, most of the onion seed is grown on the better soil types on first and second "bench" land and in the foot hills where good air drainage occurs. The climate in western Oregon, with the exception of a narrow zone along the Pacific Coast, seems to be suitable for the production of onion seed. However, the occurrence of downy mildew and yellow dwarf--two very serious diseases--in western Oregon mitigates against the expansion of the onion seed enterprise in this region.

The results of investigations on the relation of the time of seeding and transplanting to overwintering of cabbage indicate that plants going into the winter in a loose-leafed or loose- or soft-headed condition are more winter-hardy than are tight- or compact-headed ones. Late varieties of cabbage, such as Wisconsin Ballhead, planted in the seedbed between the 15th and 20th of June and transplanted to the field between the 15th and 20th of August, went into the winter in a soft- or loose-headed condition; early varieties, such as the Resistant Detroit, did so when seeded about July 5 and transplanted between the 1st and 5th of September.

Investigations on the relation of seeding date and root size to overwintering of table beet and carrot indicate (1) that carrots are more winter-hardy, under Oregon conditions, than beets, and (2) that the smaller the size of the roots the greater the hardiness. While the smaller roots are more winter-hardy than larger ones, plants from very small roots do not produce as much seed as those from larger ones, which fact must be taken into consideration in deciding upon the proper date of seeding. Beets seeded during the first week in August and grown under irrigation produced medium-sized roots, averaging 55 mm. in diameter at winter-time; carrots sown at the same time averaged 40 mm. in diameter when winter arrived. Roots of this size withstood normal western Oregon winter temperatures and made good yields of seed.

Oregon has produced a small acreage of a limited number of vegetable seed crops over a period of years and there has been a big increase in acreage during

the present emergency. Some seasons there have been considerable losses and in many cases these severe losses were caused because of lack of information. Many contracting agencies have come into this State and have put out a considerable acreage of seed crops with only limited research background as to the suitability to the particular conditions.

SEED-TO-SEED PRODUCTION OF ONIONS

By Henry A. Jones
Bureau of Plant Industry, Soils, and Agricultural Engineering

In the Imperial Valley this season there were 900 acres of onions grown for seed on the seed-to-seed basis. Practically all this was Crystal Wax and Yellow Bermuda. The Red Creole which behaves about the same as the Bermuda type should also perform satisfactorily. The other varieties of onion so far tested in the Imperial Valley have not done well.

Seed is sown about September 15. Hot weather prevents earlier seeding, and if seeded later the plants do not get sufficiently large for 100 percent bolting. The crop is grown on raised beds the same as lettuce and carrots. Yields are around 300 pounds per acre of cleaned seed. Almost no rain, dew, or fog occur in Imperial Valley, so the seed crop is free of downy mildew and other foliage diseases. Thrips have not been severe on the seed-to-seed crop, as there is no natural inoculation such as occurs when bulbs are planted and the population builds up slowly during the cool days of winter.

On the Western Slope in Colorado about 1,200 acres are being grown on the seed-to-seed basis in 1943. Most of this is Mountain Danvers, but a few other varieties are also being grown. The White Sweet Spanish, which is a rather difficult variety to store, has performed satisfactorily on the seed-to-seed basis.

Seed is sown about June 15 on raised beds, as the crop here is also grown under irrigation. An attempt is made to overwinter large plants in a green condition. The plants overwinter best if they have not started to bulb or if the overwintering bulb is small.

At present the Imperial Valley and the Western Slope of Colorado are the two main districts growing the seed-to-seed onion crop.

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AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING
DIVISION OF FRUIT AND VEGETABLE CROPS AND DISEASES

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COOPERATIVE TRIALS OF NEW AREAS FOR VEGETABLE SEED PRODUCTION IN 1944

Contents

INTRODUCTION

By E. H. Toole
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The very heavy war-time demand of the United States and her Allies for vegetable seeds has been well supplied by the seed trade. Many problems in the most economical production of seed remain; therefore studies have been continued in cooperation with several State Agricultural Experiment Stations to determine the possibilities for vegetable seed production of various areas of the Mountain and Pacific States. The results of the 1943 trials were distributed in mimeographed form in July 1944. The present report of the work in 1944 follows the same procedure of giving the results of each of the four regions as prepared by those having direct supervision of the work.

Where possible, more work was done in 1944 on the time of planting, spacing, use of fertilizers, and other cultural factors as related to the particular areas. As in the previous season, the wide distribution of the plots and war-time labor shortages prevented adequate care of some plantings. In many instances the general observations may be more revealing than the actual yield records. Interest in the work has been shown by the fact that commercial seed firms have made trial plantings in several of the areas being studied.

VEGETABLE SEED PRODUCTION TRIALS IN WYOMING, COLORADO, AND NEBRASKA

By G. B. Brown
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Tests were continued in 1944 to find new areas for production of carrot and table beet seed. Locations were generally the same as in the previous year, although the planting on dry land was made at the U. S. Dry Land Field Station at Akron, Colorado, rather than Alliance, Nebraska. No planting was made at Lincoln, Nebraska, or Olathe, Colorado, as in 1943.

Credit should be given to the following persons for their cooperation in this work: Professor A. M. Binkley of the Colorado State College at Fort Collins for making space and labor available at the Colorado Experiment Substations; J. F. Brandon of the U. S. Dry Land Field Station at Akron, Colorado, and W. C. Edmundson of the U. S. Potato Experiment Station at Greeley; Dean J. A. Hill and W. L. Quayle of the University of Wyoming for facilitating the work at Torrington; and Dr. H. O. Werner of the University of Nebraska for arranging the work at Scottsbluff and North Platte.

Plantings not made on State experimental farms or U. S. Department of Agriculture stations were made by arrangement with owners of private farms.

Roots used in most plantings were grown at the Cheyenne Horticultural Field Station and stored in sand in a root cellar. The roots were sorted before setting and any damaged or off-type roots were discarded. Varieties used were Red Core Chantenay carrot and Detroit Dark Red beet. All roots were in good condition when removed from storage, but in some cases deteriorated before setting.

Unless otherwise indicated, the seed was threshed by hand and cleaned in a fanning mill.

As tests were conducted in different ways at the several places, each test will be discussed separately. Records of all tests are given in tables 1 and 2.

Cheyenne, Wyoming: Carrots from four dates of sowing in 1943 were stored separately and set out May 6. The 1943 dates of planting were June 4, June 15, June 28, and July 15. Roots from the first two plantings were approximately the same size, and roots from the last two plantings were less than half as large. Plants from the small roots were a few days later in developing and had fewer branches, but produced as much seed as those from the larger roots. This better yield may be due to a better set of seed.

Table beets from three dates of planting in 1943 were stored separately and set out May 6, 1944. A fourth planting, made July 15, 1943, failed to produce usable roots. Roots from the first planting were largest, although the size of the root made no apparent difference in yield of seed. Many roots produced only vegetative growth, but the plants that produced seed stalks gave a heavy yield.

Rabbits injured many of the roots of both crops before growth started.

Wheatland, Wyoming: Carrots and beets grown at Wheatland from four dates of planting in 1943 were stored at Cheyenne and reset at Wheatland this spring. Carrots were approximately the same size from all four dates of planting, and development of the plants during the season was the same. The beets varied in size, those from the first planting being largest, but all plants developed at about the same time. Due to a misunderstanding, the seed of all four plantings was harvested together, making a comparison of yield impossible between the four planting dates.

Carrot and beet roots grown at Cheyenne were also set at three different dates this spring to find if any difference resulted from early setting. Development and yield of both crops were about the same in all three dates of setting. Survival of the third setting of carrots was poor, due to the poor condition of the roots when set and to rabbit injury.

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TABLE 1

DATA ON CARROT SEED PRODUCTION 1944

Station	Date transplanted 1944	Number planted	Survival at harvest	Ave. yield per plant harvested	Calculated yield per acre 1/	Germination
			Percent	Grams	Pounds	Percent
Cheyenne						
Seeded 6/4/43	5/6	67	84	33	507	92
Seeded 6/15/43	5/6	67	73	32	434	87
Seeded 6/28/43	5/6	67	85	28	440	89
Seeded 7/15/43	5/6	67	79	33	481	85
Wheatland						
Wheatland-grown roots	4/14	120	72	28	428	95
Cheyenne-grown roots	4/14	133	56	29	353	89
Cheyenne-grown roots	4/29	133	52	29	319	88
Cheyenne-grown roots	5/11	133	30	29	247	92
Sheridan	5/23	175	91	4	68	51
Jody	5/23	266	51	22	107	83
Worland						
Worland-grown roots						
Seeded 6/4/43	4/18	33	55	18	308	88
Seeded 6/14/43	4/18	33	33	29	313	88
Seeded 6/27/43	4/18	33	79	37	935	87
Seeded 7/4/43	4/18	33	67	17	354	91
Cheyenne-grown roots	4/18	66	83	29	772	90
Torrington	4/14	133	75	16	254	91
	4/29	133	86	11	198	81
	5/11	133	77	7	116	82
Akron	4/28	180	94	28	568	94
Monte Vista	5/25	250	60	18	105	85
Ft. Lewis	5/15	317	86	38	791	85
Cortez	5/1	250	92	9	817	83
Scottsbluff (2' rows)						
6" spacing	4/23	184	90	12	1003	88
12" spacing	4/23	129	89	13	544	90
18" spacing	4/23	90	90	10	313	87
North Platte (3' rows)						
6" spacing	4/7	200	95	16	1035	80
12" spacing	4/7	100	92	20	631	80
18" spacing	4/7	67	93	20	440	84

1/ Calculated from actual yield from area planted

TABLE 2

DATA ON BEET SEED PRODUCTION 1944

Station	Date transplanted 1944	Number planted	Survival at harvest	Ave. yield per plant harvested	Calculated yield per acre 1/	Germination
			Percent	Grams	Pounds	Percent
Cheyenne						
Seeded 6/4/43	5/6	37	38	194	1009	61
Seeded 6/15/43	5/6	37	46	187	1177	75
Seeded 6/28/43	5/6	37	46	200	1261	76
Wheatland						
Wheatland-grown roots	4/14	88	74	213	2541	96
Cheyenne-grown roots	4/14	100	68	160	1742	94
Cheyenne-grown roots	4/29	50	52	177	1543	92
Cheyenne-grown roots	5/11	50	56	211	1981	96
Sheridan	5/23	100	63	39	410	52
Cody	5/23	200	28	115	867	78
Worland	4/18	50	68	123	1343	87
Torrington	4/14	100	83	17	227	76
	4/29	100	81	14	182	87
	5/11	100	82	18	240	82
Akron	5/7	138	59	109	1026	85
Monte Vista	5/25	150	16	156	266	45
Ft. Lewis	5/15	178	51	133	1230	75
North Platte						
6" spacing	4/7	200	95	26	1606	40
15" spacing	4/7	80	95	42	1016	34
24" spacing	4/7	50	90	89	1275	57
Greeley						
6" spacing	4/7	225	90	43	2496	
15" spacing	4/7	100	92	89	2087	
24" spacing	4/7	65	97	122	1901	90
	4/7	65	97	122	1901	90
	4/24	65	89	116	1663	92
	5/8	65	91	126	1830	84

1/ Calculated from actual yield from area planted.

The calculated yield of seed per acre from Wheatland-grown roots was higher than that from Cheyenne-grown roots, due to a better survival. Germination was good in all cases.

Sheridan, Wyoming: Carrots and beets grown at Cheyenne were delivered to Sheridan early in April, but due to weather conditions were not set until May 23. The roots were badly wilted when set out and the weather was cold and wet until midsummer. Development of the seed was consequently very late. Roots of both crops were badly rotted at time of full flower.

Approximately 60 percent of the carrot plants were infected with aster yellows at harvest time. Because of this, many umbels had set no fruit and the yield and germination of the seed was very poor. This disease appears to be very prevalent in this vicinity as seed plants of both wild and cultivated lettuce are affected.

Yield and germination of the beet seed were poor because of the late planting and consequent immaturity of the seed. More trials should be made in this area under better conditions.

Worland, Wyoming: Carrots grown at Worland from four dates of planting in 1943 were stored at Cheyenne and set at Worland April 18, 1944. Roots from all four plantings were of good size, those from the first planting being largest. Carrots grown at Cheyenne were set at the same time for comparison. The time of development was about the same for all roots. The yields of seed from the third 1943 seeding date and from the Cheyenne-grown roots were higher, probably because of better survival of the plants. Germination was good for seeds from all plantings.

Beets grown at Cheyenne were set April 18. Growth was good and the yield of seed fair in spite of uneven seed set.

Cody, Wyoming: Beets and carrots grown at Cheyenne were delivered to Cody in April and not set out until approximately seven weeks later. The roots were badly wilted and partially decayed when set. The carrots became severely infected with aster yellows and the yield of seed was poor with only fair germination. Twenty-eight percent of the beets survived until harvest and gave a fair yield of seed.

An experimental planting of beet roots by a seed company at the same location turned out very poorly. These latter roots were also set late and had deteriorated after removal from storage. One commercial trial plot at Powell, set with beets shipped from Mt. Vernon, Washington, was fairly good, with a good set of seed. A second seed company had two small plots of beets for seed which were moderately good. The plants were rather spindly and had no central seed stalk, although set of seed was good on existing stalks. This company also had a plot of carrots for seed which was infected with what appeared to be aster yellows. The prevalence of aster yellows in this area might be a limiting factor in carrot seed production. It is believed that table beet seed can be grown successfully in this region--particularly around Powell--if methods for storage of roots can be worked out. Some sugar beets are grown in this area, but it would be possible to isolate table beet seed plots.

Torrington, Wyoming: Beet and carrot roots were set at three different dates: April 14, April 29, and May 11. The plot was located in a shaded spot and weeds developed late in the season. Seed set was poor for both crops.

At harvest time the last setting of carrots appeared less mature than the other two settings. This immature seed probably accounted for the smaller yield from the last setting. Many carrot plants died between the time of flowering and harvest, probably because of root rot. Germination was fair.

The beets were uneven in development, and many plants had secondary growth in flower at harvest time. There were only slight differences in yield between the different dates of setting. Germination of the seed was fair.

Beet seed was threshed in a small all-crop harvester which worked fairly well; but cleaning the machine between batches makes its use impractical for small quantities. Carrot seed did not thresh satisfactorily, partly because the seed was damp from recent storms. With proper adjustments, screens, etc., it would be feasible to use this type of harvester for large quantities of seed.

Scottsbluff, Nebraska: A spacing experiment was attempted with carrots spaced 6, 12, and 18 inches apart in the row. No difference in development due to spacing was observed, although the closer spacing gave a higher yield of seed. Umbels were small and seed set was poor on the majority of the plants. Severe weed competition tended to nullify the effects of spacing. The percent germination was high in all cases.

North Platte, Nebraska: Spacing experiments on beets and carrots were made with carrots 6, 12, and 18 inches apart in the row, and beets 6, 15, and 24 inches apart. The carrots in the 6-inch spacing gave a much higher calculated yield per acre than in the other spacings, although the yield per plant was smaller. Most of the plants produced seed although some died after the main umbels had ripened. The rate of development was about the same in all the spacings.

The beets spaced 6 inches apart produced only slightly more seed per acre (calculated) than those in the 24-inch spacing, while those spaced 15 inches apart produced less than either of the others. The yields were good in all cases. The low germination of the beet seed may have resulted from an admixture of immature balls from secondary growth that developed after the main crop ripened.

Greeley, Colorado: Beets and carrots were set both for spacing trials and for date of spring planting. Carrot spacings were 6, 12, and 18 inches apart in the row. Beets were spaced 6, 15, and 24 inches apart. The dates of setting were the same for both crops--April 7, April 24, and May 8. In this test for dates of setting, the carrots were spaced 18 inches apart in the row and the beets 24 inches.

The carrots showed a tendency toward less vigorous growth as planting was delayed. No difference in development could be observed in the different spacings of carrots. Grasshoppers destroyed the carrot seed crop during the last week of July.

The beets were slightly later in developing in the later settings, although the plants were of approximately the same size. There was no difference noted in development between plants in different spacing plots. The yield of seed was

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approximately the same from roots set at different dates. Per acre yield was only slightly higher from the closer spacings of beets than from the 24-inch spacing, but the 24-inch spacing gave a much higher yield per plant. The percent germination was high except for the last date of planting.

Akron, Colorado: Carrots and beets were set under dry-land conditions. Wet weather delayed planting for about three weeks after the roots were removed from storage, causing a loss of beets from root rot after setting. Carrot roots were not rotted.

Carrots made a fair growth with seed well set. Two plants were infected with what appeared to be aster yellows. Ten beet plants made vegetative growth with no seed stalks, but the remainder grew well and had a heavy seed set. An attempt was made to thresh both crops in a small plot thresher, but the machine was not adapted to these seeds.

The yield and percent germination of both crops indicate that this seed could be produced economically under conditions similar to those existing at this station.

Rocky Ford, Colorado: Carrots, from seed planted on four different dates in 1945, had been left in the ground to test the possibilities for the seed-to-seed method of production. The three later plantings had a heavy stand in August and have since been harvested, although no data or seed samples are available as yet. Carrot seed has been grown successfully in this region using both stored roots and the seed-to-seed method.

Monte Vista, Colorado: Weather conditions prevented setting of carrots and beets until May 25, about six weeks after the roots had been removed from storage. Many roots of both crops rotted after setting and failed to start growth. Only 24 beet plants of 150 set out survived to harvest. Although the yield per plant was high, there was much vegetative growth on these surviving plants, and the germination was low.

Survival of the carrots was better--over 50 percent living until harvest. Poor seed set on the second and third-order umbels probably caused the low yield. The main umbels were well set. Seed of both crops was threshed in a combine at the Ft. Lewis Station.

From the results of this experiment for the past two years, it would appear that the cold spring weather, causing delayed planting, would make commercial production uncertain in this locality. The situation might be alleviated if roots were not removed from storage until weather conditions would permit immediate planting. Further trials should be made with this in mind.

Ft. Lewis, Colorado: Beets and carrots were set May 15, about four weeks after removal from storage. Fifty-one percent of the beets survived to harvest and 86 percent of the carrots produced seed. The yield of both crops was good and germination fair.

Two rows of beets set out by a seed company appeared to have better survival than the roots from Cheyenne, although growth was less vigorous.

Carrots and parsnips for variety tests in 1943 were left in the field overwinter. These plants had survived the winter very well and developed much earlier than spring-set roots. Seed was planted at different dates in 1944 for seed-to-seed trials.

Seed at this station was threshed in a small combine, which is reported to work very well on both carrot and beet. The seed from the Monte Vista and Cortez plantings was also threshed here, through the courtesy of Mr. Dwight Koonce.

Cortez, Colorado: Carrot roots were set May 1, and although survival was good, the roots were planted too close together--3-4 inches apart--to give a satisfactory test. Growth was fair, but the plants were poorly branched. The yield per plant was small, but due to the close spacing the calculated yield per acre was fair. Germination was satisfactory. Carrot seed has been grown successfully in this region in the past.

Beets were set in this location in 1944 by a seed company, but only a few survived--probably because of the late setting and because the roots were kept too long out of storage.

Montrose County, Colorado: Carrots were set at two locations by a private individual, but failed to grow--apparently because of the poor condition of the roots when set. It is reported that some carrot seed was grown in the western part of the county this year.

Austin, Colorado: Carrots and beets were seeded at different dates in 1943 to test for winter hardiness in seed-to-seed production. None of the beets survived, but it is not known whether the failure was due to winter killing or to the burning of weeds from the field.

The stand of carrots was variable, but it appeared that this was due to the poor original stand and not to winter killing. Surviving plants made very good growth with a good set of seed. The early planting (June 7) was best, as weed control was easier than in the later plantings.

Delta, Colorado: One grower in this region was starting vegetable seed production on a fairly large scale this year. Carrots were grown in 1943 from California seed and stored in crates in a root cellar. Part of the roots were covered with canvas and these kept fairly well. The roots were set in the spring and started growth, but many plants were dying from decayed roots and others showed symptoms of bacterial blight when seen in August. The roots that had not been covered in storage are believed to be those that were planted at Montrose and failed to grow. This grower believes that seed can be grown successfully in low-cost land in this area, and has several acres of table beet growing for next year's seed.

Grand Junction, Colorado: Carrots from Cheyenne were set April 24 adjacent to a small field of the same variety also being grown for seed production. In August the plants had made only fair growth and a fair seed set. At this time many leaves had a reddish-purple tinge, suggesting a possible phosphorus deficiency. However, at harvest time, the plants were infected with a blight or fungus that had spotted most seed that was present, and no harvest was made. The

infected umbels produced small "smut balls" rather than seed. What seed was present appeared black. No evidence was found of the bacterial blight that appeared in the Delta region, 50 miles distant. A small plot of carrot seed about one mile from this location showed no evidence of disease. Work is being done to identify this infection.

General discussion: Results of the two years' work tend to show that with proper care these seed crops can be grown in most of this region. There is much evidence that storage of roots until just before setting is important, particularly with beets, as survival was poor in nearly all cases where the roots were removed from storage and allowed to stand for some time before setting. If roots could be grown and stored at the location of setting, this period of waiting for favorable weather could be avoided. Several methods of storage are being tested at Cheyenne this winter to find a way to enable farmers without adequate root cellars to store roots over winter.

The results of the spacing tests at North Platte would seem to indicate that carrots could be profitably spaced closer in the row than is customary. The closer spacing in the Cortez planting also gave a higher calculated yield per acre than plantings made with roots 18 inches apart. Beets gave a slightly higher yield in the closer spacings both at North Platte and Greeley, but the differences in yield are probably not great enough to compensate for the extra roots and work involved in planting the roots close together.

The prevalence of aster yellows in the Sheridan and Cody regions might limit carrot seed production. Sugar beet growing would limit table beet seed raising in some areas, although in others, as the Powell, Wyoming, region, it would be possible to isolate the table beet.

Southwestern Colorado would appear to be promising for beet seed production, as no sugar beets are grown and the table beet seed has been successfully grown at Ft. Lewis.

The favorable results of the test at Akron would justify further work with beet seed production on dry land, as no sugar beets are grown.

VEGETABLE SEED PRODUCTION TRIALS IN UTAH

By Leslie R. Hawthorn, Bureau of Plant Industry, Soils, and Agricultural Engineering, and L. H. Pollard, Utah Agricultural Experiment Station.

Because of change of personnel and a lapse of several months with no Federal representative on this project, the vegetable seed production work in Utah was less extensive in 1944 than in 1943.

Carrot Experiments

Carrots were grown for seed at Logan (Cache County) and Richfield (Sevier County). Carrots planted in the fall of 1943 at Cedar City (Iron County) overwintered well in the field but were destroyed by stock in the spring of 1944.

At Logan three sowings were made in 1943 for seed-to-seed production, and stecklings were planted in the fall of 1943 and the spring of 1944. The results of these trials are summarized in Table 1. The results for seed-to-seed production represent averages of 7 to 11 rows for each planting; and for stecklings, they comprise 1 to 2 rows. The plants left in the seed row over winter suffered somewhat from winter-injury, being killed out in spots; but in general survival was sufficient for a satisfactory stand and yield. The fall-planted stecklings winter-killed approximately 50%. Germination of the seed of all lots was high.

A part of the seed-to-seed plot at Logan was used to determine the effect of spring thinning of the plants to approximately 1 foot apart. As shown in Table 2 the yield per plant was increased by giving more space for development, but the yield per row was reduced.

At Richfield three sowings for overwintering in place were made in 1943, but the first two sowings suffered severe injury during the winter. It is not known whether the greater loss of plants in the first two plantings was due to the age of the plants or to soil conditions in that part of the plot. Fall-planted stecklings were completely winter-killed. The results of the Richfield trials are shown in Table 3. The spring-planted stecklings were in small plots and the results are only suggestive.

Beet Experiments

Three sowings of beet at different dates were made at Richfield (Sevier County) in 1943 for overwintering in the ground, but winter-killing was practically complete. Four sowings were made at Glendale (Kane County). There appeared to be a moderate survival of plants in the spring of 1944, but the roots had been injured by spring freezes and made very poor growth.

Stored beet roots were planted at both Richfield and Glendale in the spring of 1944; but, because of unavoidable delay in setting out the roots, stands were poor and seed production only moderate. Results of the beet trials are not presented as it is believed they do not represent the possibilities of beet seed production in Utah.

TABLE 1

SEED YIELDS AND GERMINATION OF CARROT GROWN AT LOGAN, UTAH, 1944

Treatment	Ave. distance between plants	Non-flowering plants	Calculated yield per acre	Yield per plant	Germination
	Inches	%	Pounds	Grams	%
First sowing, 6/30/43	8	0.7	871	23.9	88
Second sowing, 7/24/43	8	0.4	1132	27.2	91
Late Spring, 7/12/43	7	0.2	1138	31.6	91
Broadcast, planted 3/7/43	20	0	960	64.4	83
Broadcast, planted 10/15/43	20	2.0	822	50.5	92
Broadcast, planted 3/2/44	17	0	1040	45.4	87

TABLE 2

Yield in Seed-to-Seed Carrot Trials, as Affected by Spring Thinning on May 22, 1944, Logan, Utah.

Treatment	Planting	Calculated Yield per acre	Yield per plant	Germination
		Pounds	Grams	Percent
Unthinned	First	230	11.6	83
Thinned (1 ft.)	First	725	29.6	85
Unthinned	Second	1405	21.6	91
Thinned (1 ft.)	Second	1232	30.6	90
Unthinned	Second	1248	15.2	92
Thinned (1 ft.)	Second	908	18.1	93
Averages:				
Unthinned		1161	16.1	
Thinned		977	25.5	

TABLE 3

SEED YIELDS AND GERMINATION OF CARROT SEED PRODUCTION TRIALS AT RICHFIELD, UTAH, 1944

Treatment	Calculated Yield Clean Seed Per Acre	Clean Seed Per Plant	Germination
	Pounds	Grams	Percent
Third Sowing, 8/5/43	1478	71.8	89.5
Stecklings, planted 4/6/44			
Large	736	59.4	83
Medium-large	161	36.5	83
Medium	592	37.8	89
Medium-small	743	49.3	83
Small	500	29.5	87

VEGETABLE SEED PRODUCTION TRIALS IN ARIZONA

By Robert C. [illegible] and A. E. Griffiths,
Arizona Agricultural Experiment Station.

The growing of vegetable seed crops has become important in Arizona since 1940. Stocks normally imported from Europe were cut off at the beginning of the war, and so new areas had to be found in which to grow vegetable seeds, not only for use in the United States but also for aid to nations allied with us. Arizona, with its wide range of climate and soil conditions, has already been found to be adapted to the production of many kinds of vegetable seeds. However, development of cultural practices peculiar to Arizona have been left almost entirely up to the grower. This report presents work done at the University of Arizona's Salt River Valley Vegetable Research Farm at Tempe, Arizona, on planting methods, planting dates, fertilizer treatments, and spacing of vegetables grown for seed in the Salt River Valley.

The following kinds of vegetables were selected because previous studies indicated that these were best adapted for seed growing in this area: beet, broccoli, Chinese cabbage, carrot, collards, onion, radish, and salsify. Each vegetable was grown in plots of 1/477 of an acre. These plots were replicated from two to four times. The treatments or conditions of each investigation will be taken up under an analysis of the data.

The first plantings of vegetables were made September 2[illegible], 1943. Prior to planting, 1000 pounds of treble superphosphate and 500 pounds of ammonium sulfate per acre were broadcasted and harrowed into the soil. Plantings were made on 40-inch, flat-top lettuce beds. Spacings were as follows: beets, 6" to 12", on both sides of the bed; broccoli, 12", on one side of the bed; carrots, 2" to 12", on both sides of the bed; Chinese cabbage, 12" on both sides of the bed; collards, 10" to 12", on one side of the bed; onions, 2" to 4", on both

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sides of the bed; onion bulbs, 12" on both sides of the bed; radishes, 2" to 3", on one side of the bed; and celery, 4" to 5", on one side of the bed. A second planting of beets, broccoli (transplants), carrots, and onions (bulbs) was made on October 26. Half of the beets and carrots were lifted, sorted, and replanted in December and February for root-to-seed studies.

Side dressings of 200 pounds of sodium nitrate per acre were applied on November 20, February 3, and April 14 to all plots other than the fertilizer studies. The fertilizers were applied directly in the furrow and then irrigated into the soil. The plants showed no signs of lack of nitrogen at any time during the course of the experiments.

As soon as the seeds reached maturity, the plants were harvested and dried on screens for 2 to 3 weeks. After drying was complete, the seed was threshed and cleaned by the use of a small office cleaning mill. The cleaned seed was weighed and the results were calculated on an acre basis. Germination tests of seed from each plot and replicate were made in duplicate. The results given in this report are averages of these figures.

Beets — Effect of Time of Planting, Variety, Stand Reduction, and Spacing on Yield and Viability.

Two varieties of beets were used: Detroit Dark Red and Crosby Egyptian. Seed of each variety was planted on September 26. A second planting was made on October 26. Half of the roots from the first planting were lifted, graded and transplanted on December 3. The same procedure was applied to the second planting and roots from the October 26th planting were transplanted on February 21. Half of all four plantings were thinned to 3 inches; the other half were thinned to 12 inches. This was done in order to determine if the closer spacing would result in the control of curly top. The shading effect of closely spaced plants inhibits the spread of the beet leafhopper which carries the curly top virus disease.

Table 1 presents the data for this phase of the work. Seed were from all treatments matured on the same date, regardless of the date of planting. The early October seed produced twice as much seed as the Detroit Dark Red. The September 26th planting at 3-inch spacing yielded the largest amount of seed, but the 12-inch-spaced plants were by far the highest yield per plant. However, the germination quality of the seed from the 3-inch spacing was higher than from the 12-inch spacing which indicate that the quality of the seed was better in the 3-inch spacing. Curly top was held to a minimum in the 3-inch-spaced plots. Some curly top was in evidence in the 12-inch-spaced plots; however, it was apparent that curly top had not overcome the benefit of wider spacing in the production of more seed stalks per plant.

The yields from the October 26th planting were reduced very materially, being only about half of those from the September 26th planting.

Considerable percentages of seed from the October 26th planting were matured. Transplanted roots that were grown from the September 26th planting and transplanted December 3, resulted in reduced yields and germination percentages, as compared with roots left in place.

TABLE 1

SEED YIELD PER ACRE AND GERMINATION PERCENT OF RED TABLE BEET AS AFFECTED BY PLANTING METHOD, DATE OF PLANTING, VARIETY, TRANSPLANTING AND SPACING.

Seed-to-Seed Production

Variety	Spacing	Seeded September 10, 1943		Seeded October 26, 1943	
		Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Early Wonder	6"	5122	88	2662	59
	12"	4252	79	2336	64
Detroit Dark Red	6"	2866	79	1256	62
	12"	1850	73	836	65

Root-to-Seed Production

Variety	Spacing	Transplanted December 3, 1943		Transplanted February 21, 1944	
		Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Early Wonder	6"	1582	56	890	45
	12"	1286	66	678	42
Detroit Dark Red	6"	742	52	260	50
	12"	1078	56	134	56

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Also, transplanted roots that were grown from the October 26th planting and transplanted on February 21, resulted in reduced yields and germination percentages. In practically all cases the 6-inch spacing gave the greatest yield.

From these data, it would appear that an early seed planting, thinned to 6 to 12 inches, would give the greatest yields and the best quality seed as determined by its viability. Also, Early Wonder beet is a more prolific seeder than Detroit Dark Red.

Carrot - Effect of Date of Planting, Variety, Transplanting, and Fertilizer Treatment upon Seed Yield and Viability.

Two varieties of carrots, Imperator and the Red Core Chantenay, were planted on September 20. Some roots of each variety were dug, sorted and replanted on February 21. The transplanted stocks were set out 12 inches apart, while the seeded stocks were thinned to 6 to 8 inches. Yields given in Table 2 would indicate that there was very little difference in seed production between Imperator and Red Core Chantenay, when grown either in seed-to-seed or in root-to-seed culture. However, transplanting the roots caused a very sharp decrease in yield. This may be due to the increased spacing given to the transplanted stocks.

Germination of the seed produced was very good under all conditions. For the greatest yields, it would appear that seed-to-seed production is preferable. However, seed-to-seed production does not allow the grading and roguing of the carrot root stocks.

Table 2

SEED YIELD PER ACRE AND GERMINATION OF CARROT AS AFFECTED BY VARIETY AND TRANSPLANTING.

Variety	Planting Method	Seeded September 20, 1943		Transplanted February 21, 1944	
		Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Imperator	Seed-to-seed	1207	94		
	Root-to-seed			727	94
Red Core Chantenay	Seed-to-seed	1222	95		
	Root-to-seed			816	92
	Average	1215	95	771	93

In a second experiment, carrots were planted under different fertilizer treatments and at two dates of planting. The Imperator carrot was used and was planted on September 20 and October 26. The four fertilizer treatments were as follows:

Nitrogen--30 pounds per acre
Phosphorus (P_2O_5) -- 90 pounds per acre
Nitrogen -- 30 pounds per acre plus phosphorus (P_2O_5) -- 90 pounds per acre
Check -- No treatment

Each treatment was applied 3 times during the course of the experiment, October 25, February 3, and April 14. In addition to the above treatments, all plots had received the initial application of 1000 pounds of treble superphosphate and 500 pounds of ammonium sulfate per acre, which was broadcasted and harrowed into the soil on August 10. The nitrogen was applied as sodium nitrate, while the phosphorus was applied as treble superphosphate. All applications were given in the furrow and irrigated into the soil.

Yields per acre and germination percentages from these experiments are shown in Table 3. The second date of planting was definitely too late. Very little seed was harvested and the germination quality was low. The best yield per acre was from seed planted on September 20 with the N plus P treatment, while N alone was second. Phosphorus treatments resulted in the lowest yields. However, there is probably little, if any, significant difference between P and check, or between N plus P and N.

Germination of the seed produced was about the same for all treatments for the September 20th planting date, thus signifying that fertilizer treatments had little, if any, effect upon the viability of the seed.

TABLE 3

SEED YIELD PER ACRE AND GERMINATION PERCENT OF IMPERATOR CARROT AS AFFECTED BY FERTILIZER TREATMENT AND DATE OF PLANTING.

Fertilizer Treatment	Planting Date			
	September 20, 1943		October 26, 1943	
	Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Nitrogen	1940	96	46	83
Phosphorus	1374	96	40	63
Nitrogen plus phosphorus	2156	95	26	79
Check -- No treatment	1594	96	42	89
Average	1766	96	38	78

Onion - Effect of Date of Planting, Variety, and Fertilizer Treatment Upon Seed Yield and Viability.

The results of fertilizer treatments on the Crystal Wax onion grown for seed were similar to those on carrot. The data are presented in Table 4.

A difference of one month in planting resulted in no seed yield at all. It is apparent that a seed grower should plant his seed stocks about September 20, while a commercial bulb grower should plant about October 25 to November 1. Of the four treatments, N plus P gave the highest seed yields as well as the highest germination percentages. Nitrogen used alone was second. Phosphorus was lower still, and the check treatment was last of all. This would indicate that nitrogen used in combination with phosphorus or nitrogen used alone would result in the highest yields per acre of onion seed.

Germination was fairly high in all cases and was very slightly affected by the fertilizer treatments.

A small planting of different varieties of onion was made on September 20. The yield and germination results are shown in Table 5. Crystal Wax and Utah Sweet Spanish onions gave the greatest yields and the highest germination. All other varieties were considerably poorer in seed yield and germination.

Bulbs of four varieties of onions were set on September 20 and October 26. In most cases, as shown in Table 6, the second planting date gave the best results in seed yield and germination. Crystal Wax produced the highest seed yields. Yields from bulbs were 2 to 5 times as large as those harvested from onions grown from seed. These data would indicate that a late fall planting of onion bulbs would yield the best seed crop. For seed-to-seed production, earlier plantings are desirable.

TABLE 4

SEED YIELD PER ACRE AND GERMINATION OF CRYSTAL WAX ONION AS AFFECTED BY FERTILIZER TREATMENT AND DATE OF PLANTING.
(Seed-to-Seed Planting)

Treatment	Planting Date			
	September 20, 1943		October 26, 1943	
	Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Nitrogen	450	86	No seed produced	
Phosphorus	416	88	" "	"
Nitrogen plus phosphorus	566	91	" "	"
Check - No Treatment	404	88	" "	"
Average	459	88	No seed produced	

TABLE 5

SEED YIELD PER ACRE AND GERMINATION OF ONION VARIETIES

Variety	Pounds Per Acre	Germination Percent
Crystal Wax	401	86
Utah Sweet Spanish	464	74
Early Grano (Babosa)	0	--
Southport White Globe	70	62
Early Yellow Globe	47	65
Ebenezer	110	64
Australian Brown	70	71
Red Creole	135	74

TABLE 6

SEED YIELD PER ACRE AND GERMINATION OF ONION GROWN FROM BULBS AS AFFECTED BY VARIETY AND DATE OF PLANTING.

Variety	Date of setting bulbs			
	September 20, 1943		October 26, 1943	
	Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Southport White Globe	185	69	79	64
Crystal Wax	912	79	2154	89
Ebenezer	282	70	476	86
Early Grano (Babosa	---	--	386	82

Broccoli - The Effect of Transplanting

Italian Green Sprouting broccoli was planted on September 20, 1943. On October 26 plants taken from the September 20 planting were transplanted. Table 7 shows the yield and germination results. The yield was slightly increased by transplanting, but the germination quality was lowered markedly. If all of the low-germinating seed of the transplanted stocks could be removed, the yields would be significantly lowered. Transplanting of broccoli retards seed production in Arizona. When broccoli is transplanted, the seed is subjected to temperatures of 90°F. or higher while maturing. Temperatures of 90°F. and above cause shriveled seeds and low germination.

Miscellaneous Vegetable Seed Studies - Yield and Germination

Table 8 presents the yields and germination for miscellaneous vegetable seed crops grown in the Salt River Valley. Germination on all these vegetable seeds was very high.

TABLE 7

SEED YIELD PER ACRE AND GERMINATION OF ITALIAN GREEN SPROUTING BROCCOLI AS AFFECTED BY TRANSPLANTING.

Variety	Planting Date September 20, 1943		Transplanting Date October 26, 1943	
	Pounds Per Acre	Germination Percent	Pounds Per Acre	Germination Percent
Italian Green Sprouting	550	99	610	40

TABLE 8

SEED YIELD PER ACRE AND GERMINATION FOR MISCELLANEOUS VEGETABLES GROWN IN THE SALT RIVER VALLEY.

Variety	Pounds Per Acre	Germination
Mustard - Chinese White	687	100
Chinese Cabbage - Chihli	1426	100
Collards - Southern	6173	99
Radish - Japanese Nerma Long	297	100
Radish - Round Black Spanish	2002	100
Salsify - Mammoth Sandwich Island	691	94

SUMMARY

This report indicates that planting dates, fertilization practices, and cultural methods, such as thinning, transplanting, and spacing of root planting stock, all have very definite effects upon the seed yields and germination obtained with vegetable crops grown for seed production. Certain phases of this work are being continued during the 1944-45 growing season.

VEGETABLE SEED PRODUCTION TRIALS IN OREGON

By D. D. Hill and H. E. Finnell, Oregon Agricultural Experiment Station, and P. W. Miller, Bureau of Plant Industry, Soils, and Agricultural Engineering.

The work on vegetable seed production in Oregon in 1944 was carred out at Corvallis, (Benton County), and at Coquille (Coos County) and included trials with cabbage, carrot, and beet.

Cabbage Trials at Corvallis

At Corvallis an extensive study was made of the effect of date of seeding, time of transplanting, and size of plants on cabbage seed production. The variety used was Marion Market. Seed was sown June 25 and July 5, 1943, and from each seed bed plants were set in the field 50, 60, and 70 days later. The plants were classified as small, medium, and large. Four randomized replications were made of each treatment. The plants were spaced 18 inches apart in 5-ft. rows. Individual plots were approximately 1/194 acre.

An analysis of variance of the yield data indicated highly significant differences for date of seeding and for age of plants. No significance was shown for size of plants or for any interaction. The average yields are summarized in Table 1. The yields for different plant sizes are combined since no significant differences were found.

TABLE 1

Average Yield of Marion Market Cabbage Seed Grown at Corvallis, Oregon, from Plants of 3 Different Ages and from 2 Dates of Seeding. Individual Values Calculated from 12 Replicates (3 Plant Sizes Combined).

Date Seed Sown	Average yield of seed per acre (lbs) for plants set at following ages: 50 days	60 days	70 days	Average
June 25, 1943	600	611	742	651
July 5, 1943	689	775	812	759
Average	645	693	777	705

Yield differences required for signif.	5%	1%
Between means of 12 (indiv. means)	106.75	145.10
Between means of 24 (ages)	73.26	97.82
Between means of 36 (dates of seeding)	59.26	78.69

All plants set when 50 and 60 days old from both dates of seeding produced solid heads in the fall. These required slashing in the early spring to facilitate emergence of the flower stalk. Most of the 70-day-old plants set from the July 5 seedbed formed loose heads in the fall and few required slashing in the spring. These yield responses may not be representative of results in average years as the winter of 1943-44 was comparatively mild and did not cause

as much injury to solid heads as is usually expected. Moreover, the weather appeared to be favorable for bolting of less well developed plants. The germination of the seed produced was not affected by the time of seeding or age of the plants. The average germination of all plots was 82%.

Another smaller plot was set with 70-day-old plants of three sizes spaced 24 inches in the row. The average yields are shown in Table 2.

TABLE 2

Average Yields of Marion Market Cabbage Seed From Plants of Three Sizes When Set at 70 days of Age Spaced 24 Inches in The Row:

Plant Size	Average yield in pounds per acre
Small	700
Medium	596
Large	576
Average	624

In this experiment there is some indication of higher yield from the smaller plants. The two experiments (Tables 1 and 2) while in the same field, may not be entirely comparable; but the results indicate superiority for 12-inch spacing in comparison with 24-inch for the same age of plants.

Other trials at Corvallis compared an early, a midseason, and a late variety of cabbage. The results of all the trials with cabbage at Corvallis lead to the following general observations.

The relation of the time of seeding and transplanting to winter hardiness of cabbage. Plants going into the winter in a loose-leafed or loose-headed condition were more winter-hardy than were plants with tight or compact heads. An early variety of cabbage (Resistant Detroit) seeded on July 5 and transplanted on September 3 went into the winter in a loose-leafed or loose-headed condition. There was practically no winter injury in this plot while transplantings made on August 3 and on August 13 went into the winter in a tight-headed condition and the outer leaves of the heads were badly injured in spite of a mild winter. A late variety of cabbage (Wisconsin Ballhead) seeded on June 14 and transplanted on September 2 went into the winter in a loose-leafed or loose-headed condition. Practically no winter injury occurred in this plot, whereas transplantings made on August 3 and on August 13 went into the winter in a tight-headed condition and the outer leaves were injured considerably.

The relation of the time of seeding and transplanting to cabbage seed stalk formation. The results of previous investigations indicate that the diameter of the stems of the plants at the time they go into winter is one of the more important criteria for determining whether or not the plants will send up seed-stalks the following year. Our studies also suggest that the greater the diameter of the stem the greater the likelihood that the plant will bolt. Thus, in our investigations the lowest percentage of bolting (12%) occurred in a plot of Wisconsin Ballhead which was transplanted on September 12, 1943. At

the time these plants were set out they averaged only 3/16 inch in diameter at or near the ground line. On November 12, 1943 the stems of these same plants averaged 5/16 inch in diameter at the ground level. Plants with stems averaging 1/2 inch or more in diameter on the same date bolted with only a very few exceptions.

The relation of the date of seeding and transplanting to the production of cabbage seed. These investigations indicate that, all other things being favorable, the earlier the plants are set out the greater the amount of seed produced, if they escape winter injury. In general, plants going into the winter in head produced more seed than those that went into the winter in a loose-leafed condition. The seed stalks from headed plants were, as a rule, sturdier and larger in diameter with more lateral branches. There are doubtless considerable food reserves stored in the heads and these reserves probably account for the increased growth and seed production. In the case of early varieties, as the Resistant Detroit, there was not so much difference in the seed produced from late in comparison with early transplantings made late in 1943 because of severe winter-damage to the heads, even with a comparatively mild winter.

The relation of fertilizers to the production of cabbage seed. The results of investigations on the relation of fertilizer practices to the production of cabbage seed were very erratic. In some plots, the use of 16-20-0 ammonium phosphate at the rate of about 3000 pounds per acre, applied part in the fall and part in the spring, caused up to 36 % increase in yield, whereas in other fertilized plots, little, or no, increase was apparent.

Beet and Carrot Trials at Corvallis

Trials at Corvallis on beet and carrot seed production included studies of (a) the relation of date of seeding, date of transplanting, root size, and fertilization to winter-hardiness and to maximum production of seed; (b) the relation of time of seeding and of transplanting to the viability of the seed produced; and (c) the best methods of overwintering rootstocks.

The results of these trials are summarized as follows: The relation of the date of seeding and the size of root to the winter-hardiness of table beets and carrots. These investigations were inconclusive due to the fact that the 1943-44 winter temperatures at Corvallis, Oregon, were not sufficiently low to cause any significant injury to any plantings of either beets or carrots left to overwinter in the ground.

The relation of the date of seeding and transplanting to the production of table beet seed. Seed-to-seed or fall root transplantings produced more seed per acre than spring root transplantings. However, on an individual plant basis, the fall root transplantings produced the most seed per plant, followed by the early spring root transplantings and seed-to-seed (fall) plantings in the order named. Late spring transplantings (May 6) produced the smallest amount of seed per plant. The increased production of the seed-to-seed plantings on an acre basis is due to the fact that there were more plants per acre in this plot than in the fall or the spring root transplantings.

The relation of root size to the production of beet seeds. Although the results of studies on the relation of root size to the production of beet seeds were erratic, they indicate, on the whole, that the larger the roots the greater the amount of seed produced. Thus, roots measuring from 15-45 mm. in diameter produced on the average 27.4 grams of seed per plant; those measuring from 44 to 81 mm. produced an average of 44.1 grams of seed per plant; while roots measuring from 127 to 203 mm. in diameter averaged 54.2 grams of seed per plant.

The relation of fertilizers to the production of table beet seed. The results of investigations on the relation of fertilizers to the production of table beet seed were erratic. In some plots applications of nitrogenous and phosphorus fertilizers apparently increased production, while in others little or no increase was evident. The increase in production from fertilization was greatest in the fall-seeded (seed-to-seed) plots.

The relation of the date of seeding and transplanting to the production of carrot seed. In general, the seed-to-seed plantings and fall root transplantings produced more seed per acre than the spring root transplantings. Thus, seed-to-seed plantings made August 7, 1943, produced on the average 37.3 grams of seed per plant; root transplantings made in the fall (November 12, 1943) produced an average of 33.2 grams of seed per plant; while root transplantings made in the spring (March 29, 1944) averaged only 16.2 grams of seed per plant.

The relation of fertilizers to the production of carrot seeds. The results of studies on the relation of fertilizers to the production of carrot seed were erratic. In some plots fertilization with 16-20-0 ammonium phosphate apparently increased production while in others little or no increase was evident. On the whole, the increase in production from fertilization appeared to be greater in the transplanted root plots than in the seed-to-seed plantings.

The relation of the time of seeding and transplanting to the viability of table beet and carrot seed. Seed produced from seed-to-seed plantings and from fall (1943) root transplantings had, in general, a higher germination than seed from spring (1944) transplantings.

Studies of the method of overwintering table beets and carrots. The results of pertinent studies indicate that both beets and carrots can be overwintered without deterioration in either two ways: (a) in a well-drained earth pit, or (b) in a well-insulated building. Our studies indicate that an earth pit 1 to 2 feet in depth is superior to surface "pitting", i.e., to piling the roots in a heap on the surface of the ground and covering with a layer of soil. The pit should be located on high, well-drained ground that is not subject to flooding as immersion in water affects the keeping quality adversely. While the roots retain their normal turgidity better in a pit than in storage in a storehouse the latter has some advantages not possessed by the pit method, among which are: (a) the roots can be kept under constant observation so that if storage rots or deterioration begins to develop decayed roots may be removed to prevent spread of the trouble; and (b) the roots can be sorted at one's leisure during the winter months in comfort and all diseased and off-type roots discarded. The standard "cleated" onion crate proved to be an excellent container in which to store both beets and carrots. These crates have openings on all six sides, thereby providing very good ventilation. They can be stacked on top of one another without danger of injury to the roots, thereby making the most efficient use of space.

The building in which the roots are stored must be well-insulated and provision made for heating it in case of very cold weather. Moreover, provision must be made for maintaining the humidity above 95 percent or the roots will lose their turgidity. This is very important since roots that have lost their turgidity are worthless for seed purposes. A foot of fresh moist sawdust on the floor, moistened at periodic intervals with water from a sprinkling can or hose will keep the humidity well above the 95 percent.

Trials at Coquille

Seed production trials with cabbage at Coquille included date of transplanting, plant spacing, size of plants, and fertilization. Trials with carrot and beet included seed-to-seed production and transplanted roots, with tests of row and plant spacing and various combinations of fertilizers. Because of wartime conditions, adequate help and equipment could not be provided for satisfactory care of the plots. All seed yields were disappointingly low. No records of seed yields are presented as it is believed that the results do not tell a true story of the possibilities of vegetable seed production in the area. Even though the seed yields were low, definite effects were noted in the fertilizer plots. This was particularly true with beets and cabbage; results with carrots were not entirely consistent. In the beet and carrot plots the results could be seen from the appearance of the plants as well as in the seed yields. In all cases the non-fertilized plots were the poorest. Those that had 16-20-0 with superphosphate and boron were outstanding. In most cases the next best plot was 16-20-0 and boron. The 16-20-0 with superphosphate was superior to 16-20-0 alone, although the latter was considerably better than the check plot. The seed produced by both beet and carrot was comparatively low in germination.

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OREGON STATE COLLEGE
SCHOOL OF AGRICULTURE EXPERIMENT STATION
EXTENSION SERVICE

CORVALLIS

Corvallis, Oregon
July 16, 1947

Gentlemen:

During the current growing season we are conducting a number of trials with cabbage, onion, parsnip, spinach and table beed seed. Some of these experiments are continuations of the fertilizer work started during the previous year, but all are concerned with trials aimed at improving the quality and quantity of vegetable seed returned to the grower.

These experiments are conducted through the entire cycle, i.e. until the seed is harvested. However, I have summarized the information at this time which, I thought, might be useful to you in planning your operations for the coming season. The information in the following pages concerns itself primarily with the influence of the method of planting and use of fertilizer on bolting and winter survival of cabbage. In one case the New York State Ballhead and Early Jersey Wakefield varieties were used. In the other trial a total of 19 varieties of early, medium and late varieties were used. In this experiment some cabbage was harvested and weighed to determine the length of time it would take to get overmature or undesirable heads for seed production in the different varieties. One variety did not form a head any time during the entire season. From stem measurements in the field there are strong indications that the cabbage made growth in January, in spite of the cold weather.

In the work with the table beets nine varieties were used. These were obtained from growers and from seed houses. The object was to obtain information on diseases present in certain beet fields used for seed production. The germination of the beets was checked before planting. The plant pathologist at the Experiment Station made observations but was unable to isolate any disease. Observations were made on the overwintering qualities of small and large roots transplanted in the spring and fall, and on plots used for seed-to-seed production.

Some of the work with parsnips is of interest because of the stand obtained under different cultural practices. A little work on cucumbers and squashes is started but none of the data are included in this report.

Sincerely yours,

Mehno Groeneveld

Mehno Groeneveld
Research Assistant
Farm Crops Department

DATE-OF-PLANTING TRIAL OF NEW YORK STATE BALLHEAD AND EARLY JERSEY WAKEFIELD CABBAGE VARIETIES

The object of this experiment was to determine the influence of fertilizers on bolting, overwintering and seed production. In each series of the experiment the seed-to-seed plots were planted with Planet Jr. set on hole 5. Later these rows were thinned to one plant every 18 inches. At planting time one row was side dressed with 1000 lbs. per acre of 5-10-10. In March this row received 1000 lbs. 5-0-0. Borax and sulfur each were added at the rate of 30 lbs. per acre. The other row in the seed-to-seed plots received no fertilizer.

Some plots were transplanted 30 days after seeding. Those plots receiving fertilizer were handled similarly as the fertilizer seed-to-seed plots.

Four series of replications were planted: July 1, July 15, August 5, and August 31. The dates of transplanting were August 1; 15; September 5; and October 1. Three replications were made of New York State Ballhead and one of Early Jersey Wakefield varieties.

Results: Figures are shown in Tables I and II.

The application of fertilizer induced earlier bolting and produced firm heads, particularly in the New York State Ballhead variety. Some of these heads were extremely large, particularly in the first series, but no winter damage was apparent. One of these replications having large heads was not slashed, and it has not suffered on that account.

The incidence of soft rot was greater after bolting where large heads were formed, and this may have an effect on yield. Where the number of dead plants increased between the count made in April and in June it could generally be attributed to soft rot.

The critical planting period for this cabbage was between July 5 and August 5 depending on treatment. The third series transplanted September 5 without fertilizer gave less than 10% bolt. When fertilizer was added bolting was slightly over 30%. However, when fertilizer was added to seed-to-seed plots the bolting jumped to 70.60%. It is interesting to note the rate of growth of these plots as measured by the increase in stem size.

Size of Cabbage Seed Stalks in Inches

Date Measured	Transplanted	Transplanted & Fertilized	Seed-to-Seed	Seed-to-Seed & Fertilized
January 4	.67	.87	.778	.92
February 8	.76	.87	.781	1.02
March 16	1.04	1.18	1.06	1.34
April 12	1.19	1.34	1.18	1.47
June 16	1.35	1.53	1.33	1.53

Although the stem size of the unfertilized seed-to-seed plot never equaled the diameter of the stem in the fertilized transplanted plot, the actual bolting percentage was slightly higher. It has been known that fall

growth is important to bolting percentage, but perhaps the smallest diameter for bolting should be established for each variety, and the grower be acquainted with it. This stem size for the Ballhead variety should be equal to 1.00 inch by January. The stem size is measured just below the head.

Early Jersey Wakefield Variety

The results of this experiment with an early variety show that winter injury may be much more serious than the lack of bolting. In all cases there was winter injury where the seed was sown July 1 and 15th, and transplanted August 1 and 15th. However, fertilization in the July 1 planting showed considerable winter injury, while in the July 15 planting the winter injury was no greater than some fertilized plots.

The plots sown August 5 and transplanted September 5 had least winter injury and at the same time bolted 100%. The amount of growth is indicated by the increase in stem size and the measurements taken at various dates are shown below:

Size of Cabbage Stalks of the Early Jersey Variety (in Inches)

Date Measured	Transplanted	Transplanted & Fertilized	Seed-to-Seed	Seed-to-Seed & Fertilized
January 4	.61	.79	.63	.69
February 8	.74	.79	.66	.83
March 16	1.00	1.01	.87	1.12
April 12	1.10	1.27	.97	1.18
June 16	1.16	1.27	No Data	No Data

In general bolting was unsatisfactory when this strain of Early Jersey Wakefield was planted August 31, and transplanted October 1. (Data shown in Table IL)

Time of Planting

The New York State Ballhead Variety, chosen as the representative of the difficult bolting varieties, suffered little injury from early planting and heavy fertilization, but the best looking and best bolting plots were sown July 15 and transplanted August 15. We transplanted 30-day-old plants, but if older plants are used, such as 60-day-old plants, head formation will be delayed. However, in late plantings fertilization will increase growth and may make the difference between satisfactory and unsatisfactory bolting.

The Early Jersey Wakefield was chosen as the representative of the early variety. In this variety the formation of firm heads during the fall is undesirable, and when overmature heads are formed (that is, when the heads are cracked) this variety is particularly susceptible to winter killing. The winter injury may not always be immediately apparent; as a considerable number of plants died between April 12 and June 19.

The first planting of Early Jersey Wakefield variety was made less winter hardy by the application of the complete fertilizer. The desirable planting time of this variety depends upon general growing conditions and fertility

of the soil, but the maximum stem size in January should probably not exceed 1.00 inch and the minimum should probably not be less than .60 inch. The most satisfactory planting time in Corvallis last year was the first part of August and transplanting time the first part of September.

The final results are best shown in the amount of seed produced and it is hoped that the report will be available to you this fall showing the complete growth relationships and the amounts of seed produced from the various plots.

Results so far show that fertilization is desirable; particularly on the late planted seed. Early varieties may suffer more winter injury when heavily fertilized and planted early. In these varieties the early plantings should be fertilized with caution if at all. Late varieties need less fertilization when planted early, but on the whole they are less susceptible to winter injury.

CABBAGE VARIETY TRIALS TO DETERMINE VEGETABLE AND SEED YIELD ON CHEHALIS SILTY CLAY LOAM

The first part of the experiment shows the vegetable yield in terms of tons of edible cabbage heads produced. Some observations were made on 19 varieties on such points as uniformity and quality of the cabbage head.

In all varieties 20 feet were sown seed-to-seed and thinned to 18-inch spacing. Twenty feet were planted with 30-day-old plants sown in the seedbed July 1, and twenty feet were planted with 60-day-old plants from a seedbed sown July 1.

Results of the Vegetative Experiment: (Figures shown in Table III)

The early and medium early varieties formed quite a number of solid heads by the first part of October and practically all were ready to harvest the latter part of October. At the time of harvest the Golden Acre varieties were badly cracked; but one strain of this cabbage had twice as many cracked heads as another strain. Winter killing was exceedingly heavy in all strains of Golden Acre.

There was less injury where the heads had not matured, and least injury in the slow growing or late varieties. The difference in yield of cabbage heads is particularly pronounced between stock A222 of Wisconsin All Season (yield 11.37 tons per acre) and stock W. C. of Wisconsin All Season (yield 28.85 tons per acre). Where no cracking occurred the cabbage may not have produced its maximum yield at harvest time, but in a number of cases the low yield may have been due to the stock seed used.

Results of the Seed Trial: (Figures shown in Table III)

The seed-to-seed trials suffered approximately 30% greater winter damage in all trials as compared to the plots transplanted. The 30-and-60-day transplanting suffered approximately equal amounts of winter damage. In November the 60-day transplants had less growth than the 30-day transplants, but by February the development was practically the same.

The winter injury was greatest in the varieties where the heads cracked most. These varieties included Golden Acre, Resistant Detroit, Copenhagen Market, Ferry Round Dutch, and Wisconsin All Season. As in the previous experiment it was again indicated that the cabbage is particularly susceptible to winter damage when it enters the winter somewhat "overmature." Overmaturity refers to varieties with cracked heads at harvesting time.

The size of stem at transplanting time is shown in a separate column.

STAND AND SURVIVAL DATA ON SEVERAL VARIETIES OF TABLE BEETS

For a number of years the seed trade found difficulty with table beet production, and many have suggested that the cause was a disease transmitted from the root to the seed. With this in mind a trial was started to make observations on various varieties obtained from various sources, some of which were said to be diseased and some of which were said to be normal.

Methods

The entire cycle from germination to seed harvest will be followed, and this preliminary report is of interest mainly for the survival of the beets handled under various conditions during the winter. In the fall (November 11, 1946) a number of rows were dug and the beets separated into two groups, one of large roots and one of small roots. Some of each were transplanted immediately and some roots were put in sawdust for winter storage and transplanted during the first part of March.

Several rows were thinned in the fall, and left in the ground without transplanting; that is, seed-to-seed production.

A count of roots was made April 19 to determine the stand at that time, and again June 19 to determine the total survival at that time.

Results: (Data shown in Table IV)

The germination was commercially acceptable in all but one case, Plot VI. But even in Plot VI a good stand was obtained. The U.S.D.A. Plant Pathologist, Dr. Paul Miller, found no diseased condition in any of the plots.

The survival of the beets of all varieties is as follows: Large Roots Spring transplanted 85%; Small Roots Spring transplanted 56.7%; Large Roots Fall transplanted 78.5%; Small Roots Fall transplanted 63.8%; seed-to-seed 55.6%.

At this time the rating for vigor and potential seed production would be in the following order: First (Best): large roots fall transplanted; second, seed-to-seed production; third, small roots fall transplanted; fourth, large roots spring transplanted; fifth, small spring transplanted. Practically every beet in the experiment bolted.

It is of interest that in each case the mortality of the small transplanted roots is rather high, and that the total survival of small and large fall transplanted roots is 71.4% and of the large and small spring transplanted roots is 70.8%.

It should be noted that the survival of individual varieties differs from the average of the experiment. The Lutz Green Leaf survived best and the Short Top Detroit in Plot VI survived least.

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TABLE I

CABBAGE: DATE OF PLANTING TRIAL NEW YORK STATE BALLHEAD VARIETY ON CHEHALIS SILTY CLAY LOAM

1st Series seed-to-seed sown Transplant 8-1-46	Transplanted Only				Transplanted & Fertilized #				Seed-to-Seed				Seed-to-Seed & Fertilized #			
	# Plants	# Plants dead	# Bolting	% * Bolting	# Plants	# Plants dead	# Bolting	% * Bolting	# Plants	# Plants dead	# Bolting	% * Bolting	# Plants	# Plants dead	# Bolting	% * Bolting
Counted 4-12-47	20	0	15	75.00	20	0	19	95.00	20	2	16	88.80	20	0	20	100.00
Counted 6-19-47	20	2	18	100.00	20	1	19	100.00	20	2	17	94.50	20	0	20	100.00
2nd Series seed-to-seed sown 7-15-46 Transplant 8-15-46																
Counted 4-12-47	18	0	16	38.80	19	2	17	100.00	20	0	18	90.00	21	0	18	88.57
Counted 6-19-47	18	3	15	100.00	19	3	16	100.00	20	3	17	100.00	21	4	17	100.00
3rd Series seed-to-seed sown 8-5-46 Transplant 9-5-46																
Counted 4-12-47	20	0	1	5.00	20	3	5	29.40	21	0	7	33.33	19	2	12	70.60
Counted 6-19-47	20	1	2	9.50	20	3	5	29.40	21	0	7	33.33	19	2	12	70.60
4th Series seed-to-seed sown 8-31-46 Transplant 10-1-46																
Counted 4-12-47	19	0	0	0.00	16	0	0	0.00	16	0	0	0.00	18	0	0	0.00
Counted 6-19-47	19	0	0	0.00	16	0	0	0.00	16	0	0	0.00	18	0	0	0.00

* Bolting % Calculated on number of live plants at counting time

\# Plots were side dressed with 1000 lbs. 5-10-10 at planting and transplanting time respectively. In the spring (March) 1000 lbs. of 5-0-0 were applied. In each case 30 lbs. of sulfur and 30 lbs. of Agricultural borax were added to the mixture.

TABLE II

CABBAGE: DATE OF PLANTING TRIAL EARLY JERSEY WAKEFIELD VARIETY

1st Series seed-to-seed sown 7-1-46 Transplant 8-1-46	Transplanted Only				Transplanted & Fertilized //				Seed-to-Seed				Seed-to-Seed & Fertilized //			
	# Plants	# Plants dead	# Bolting	% * Bolting	# Plants	# Plants dead	# Bolting	% * Bolting	# Plants	# Plants dead	# Bolting	% * Bolting	# Plants	# Plants dead	# Bolting	% * Bolting
Counted 4-12-47	20	7	13	100.00	20	9	11	100.00	20	4	16	100.00	20	12	8	100.00
Counted 6-19-47	20	10	10	100.00	20	13	7	100.00	20	5	15	100.00	20	13	7	100.00
2nd Series seed-to-seed sown 7-15-46 Transplant 8-15-46																
Counted 4-12-47	20	7	13	100.00	19	2	17	100.00	20	6	14	100.00	20	2	17	94.50
Counted 6-19-47	20	7	13	100.00	19	2	17	100.00	20	7	13	100.00	20	6	14	100.00
3rd Series seed-to-seed sown 8-5-46 Transplant 9-5-46																
Counted 4-12-47	20	2	17	94.50	20	3	15	88.40	20	0	15	75.00	20	0	20	100.00
Counted 6-19-47	20	3	17	100.00	20	4	16	100.00	20	0	20	100.00	20	5	15	100.00
4th Series seed-to-seed sown 8-31-46 Transplant 10-1-46				/				/				/				/
Counted 4-12-47	16	no	0	0.00	17	no	0	0.00	18	no	0	0.00	17	no	0	0.00
Counted 6-19-47	16	data	1	6.25	17	data	1	5.88	18	data	4	22.20	17	data	5	29.40

* Bolting % calculated on number of live plants at counting time.

/ Bolting % calculated on number of plants.

// Plots were side dressed with 1000 lbs. 5-10-10 at planting and transplanting time respectively. In the spring (March) 1000 lbs. of 5-0-0 were applied. In each case 30 lbs. of sulfur and 30 lbs. of Agricultural borax were added to the mixture.

CABBAGE VARIETY TRIAL TO DETERMINE VEGETABLE AND SEED YIELD ON CHEHALIS SILTY CLAY LOAM

Seed-to-Seed Plots Planted July 1, 1946

30-Day Transplanted Plots Planted Aug. 1, 1946 - 60-Day Transplanted Plots Planted Sept. 1, 1946

	Vegetable Data /					Seed-to-Seed Plot*			30-Day Transplt. Plots				60-Day Transplt. Plots			
Variety and Stock #	Harvested	# of Heads	# Heads Split	Yield Tons/A	Bolting Data Taken	# of Plants	# Plants Dead	# Plants Bolted	# of Plants	# Plants Dead	# Plants Bolted	Stem Size at Transplt'g.	# of Plants	# Plants Dead	# Plants Bolted	Stem Size at Transp.
Resist.Detroit-W.C.	11-6-46	43	6	23.11	4-12-47	12	5	0	12	0	0	5/32 in.	13	1	0	14/32in.
					6-16-47	12	7	5	12	0	12		13	1	12	
Copenhagan Market 7170	11-6-46	44	5	30.37	4-12-47	13	8	0	13	5	0	6/32 in.	13	5	0	12/32to
					6-16-47	13	8	5	13	6	7		13	5	8	16/32in.
Copenhagan Market 24013SS	11-6-46	44	3	27.58	4-12-47	13	8	0	13	5	0	7/32 in.	13	5	0	12/32to
					6-16-47	13	11	2	13	7	6		13	5	8	16/32in.
Red Rock 8548	No Heads	Harvested			4-12-47	13	0	0	13	0	0	7/32 in.	13	0	0	16/32in.
					6-16-47	13	1	12	13	1	12		13	1	12	
All Head Early	1-4-47	42	4	32.12	4-12-47	13	1	0	13	1	0	8/32 in.	13	0	0	15/32to
					6-16-47	13	4	9	13	0	13		13	0	13	18/32in.
Marion Market W.C.	1-4-47	44	4	24.68	4-12-47	13	0	0	13	0	13	5/32 in.	13	0	13	16/32in.
					6-16-47	13	0	13	13	0	13		13	3	10	
Golden Acre 8126	11-6-46	45	12	30.67	4-12-47	13	10	0	13	11	0	7/32 in.	13	11	0	16/32in.
					6-16-47	13	13	0	13	11	2		13	11	2	
Wisconsin Golden Acre W.C.	11-6-46	40	19	26.49	4-12-47	13	8	0	13	11	0	7/32 in.	13	10	0	12/32in.
					6-16-47	13	12	1	13	12	1		13	10	3	
Golden Acre 29032SS	11-6-46	42	26	30.06	4-12-47	13	7	0	13	11	0	7/32 in.	13	9	4	14/32in.
					6-16-47	13	11	2	12	12	1		13	9	4	
Early Drumhead 5079	1-4-47	15*	0	10.57	4-12-47	13	2	0	13	0	0	6/32 in.	None Planted			
					6-16-47	13	2	11	13	0	13		..	..		
Wisconsin All Season A222	1-4-47	44	3	11.37	4-12-47	14	0	0	13	0	0	7/32 in.	13	1	0	2/32in.
					6-16-47	14	3	11	13	1	12		13	2	11	
Penn.State Ballhead A237	1-4-47	43	2	33.81	4-12-47	12	1	1	13	1	2	7/32 in.	13	0	1	16/32in.
					6-16-47	12	1	11	13	1	12		13	2	11	
Wisconsin Bugner W.C.	1-4-47	43	0	23.29	4-12-47	13	0	2	13	0	0	5/32 in.	13	1	2	20/32in.
					6-16-47	13	1	12	13	1	12		13	1	12	
Wisc.Hollander W.C.	1-4-47	42	0	14.45	4-12-47	13	0	1	13	0	5	5/32 in.	13	1	3	18/32in.
					6-16-47	13	0	13	13	1	12		13	4	9	
Stein Flat Dutch SPKS	1-4-47	41	3	24.14	4-12-47	13	1	0	13	1	2	7/32 in.	13	0	0	16/32in.
					6-16-47	13	1	12	13	1	12		13	0	13	
Ferry Round Dutch 8358	1-4-47	30	16	19.36	4-12-47	13	3	1	13	1	2	5/32 in.	13	0		14/32in.
					6-16-47	13	2	10	13	0	13		13	5	8	
Pr. Late Flat Dutch 911655	1-4-47	6	0	2.60	4-12-47	13	0	0	13	3	0	4/32 in.	Not Planted			
					6-16-47	13	1	11	13	3	10		.	.		
Wisc. Hollander 1-63655	1-4-47	44	0	18.81	4-12-47			NO	DATA		TAKEN					
					6-16-47	13	1	12	13	1	12	4/32 in.	13	0	13	12/32 to 16/32
Wisc. All Season W.C.	1-4-47	42	1	28.85	4-12-47	13	2	0	13		0	6/32 in.	13	1	0	16/32to
					6-16-47	13	4	9	13	5	8		13	3	10	18/32in.

/ For Vegetable--the seeds were planted in a row and thinned later. * For seed-to-seed plots about 3/4 to 1 lb. was sown per acre.

TABLE IV

STAND AND SURVIVAL DATA ON SEVERAL VARIETIES OF TABLE BEETS

Planted on Chehalis Silty Clay Loam. Germination of all lots except VI above 80%; lot VI 69% Perfect Stand = 15

Plot Variety	Observation	Lar.Root Spr.Trans.	Sm.Root Spr.Trans.	Lar.Root Fall Trans.	Sm.Root Fall Trans.	Seed-to-Seed
I*Detroit Dark Red	Size transplanted 11-16-46	none ✓	none ✓	2.75"	1.13"	
	Plant survival 4-19-47	. .	. .	12	15	8
	Plant survival 6-19-47	. .	. .	10	11	6
II Crosby Egyptian	Size transplanted 11-16-46	2.88"	1.40"	3.25"	1.00"	
	Plant survival 4-19-47	15	15	15	15	13
	Plant survival 6-19-47	15	6	15	10	13
III* Early Wonder	Size transplanted 11-16-46	2.80"	1.60"	3.00"	1.5"	
	Plant survival 4-19-47	15	15	12	9	7
	Plant survival 6-19-47	9	8	12	8	6
IV Detroit Dark Red	Size transplanted 11-16-46	2.78"	1.35"	3.25"	1.25"	
	Plant survival 4-19-47	15	15	13	12	9
	Plant survival 6-19-47	13	8	13	10	8
V* Perfected Detroit	Size transplanted 11-16-46	2.78"	1.50"	3.25"	1.25"	
	Plant survival 4-19-47	15	15	13	14	11
	Plant survival 6-19-47	11	11	13	14	10
VI Short Top Detroit	Size transplanted 11-16-46	2.95"	1.50"	2.75"	1.00"	
	Plant survival 4-19-47	15	15	7	10	6
	Plant survival 6-19-47	10	5	6	4	6
VII Tall Top Wonder	Size Transplanted 11-16-46	3.00"	1.30"	3.25"	1.13"	
	Plant survival 4-19-47	15	15	11	13	14
	Plant survival 6-19-47	14	11	10	8	13

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Table IV (Continued)

Plot Variety	Observation	Lar.Root Spr.Trans.	Sm.Root Spr.Trans	Lar.Root Fall Trans.	Sm.Root Fall Trans.	Seed-to-Seed
VIII Lupt.Perf Detroit	Size transplanted 11-16-46	2.88"	1.50"	3.00"	1.38"	
	Plant survival 4-19-47	15	15	14	6	12
	Plant survival 6-19-47	15	8	14	8	9
IX Lutz Green Leaf	Size transplanted 11-16-46	2.75"	1.15"	2.75"	0.88"	
	Plant survival 4-19-47	15	15	13	15	14
	Plant survival 6-19-47	15	11	13	13	14

/ No roots available for transplanting
* Lots sent in as being diseased. All plots received an application of 30 lbs. /A of sulfur and 30 lbs. of borax.

STAND AND SPACING TRIAL OF HARRIS MODEL PARSNIPS

In this trial parsnips were sown in July in a number of 30-foot rows. Some of these rows were thinned and left for seed-to-seed production. Four replications had a spacing of 12 inches within the rows; another four were spaced 6 inches; and four were spaced 3 inches. A similar series were transplanted in the fall (November 19), and in the spring (March 24). The transplanted parsnips were not selected for size.

Results: The table below shows the stand survival under the various treatments.

Spacing	Repl.	Stand	Dead	Bolting	* % Bolting 6-19	Stand	Dead	Bolting	* % Bolting 6-19	Stand	Dead	Bolting	* % Bolting 6-19
3"	1	120	0	All	100.00	80	44	All	66.7	11	109	11	9.2
	2	110	10	. .	91.8	76	44	. .	63.3	7	113	7	5.8
	3	94	26	. .	78.3	78	42	. .	65.0	36	84	18	15.00
	4	103	17	. .	86.00	94	36	. .	78.3	25	95	14	11.6
6"	1	60	0	All	100.00	45	15	40	66.7	11	49	6	10.0
	2	60	0	. .	100.00	51	9	51	85.0	15	45	10	16.7
	3	57	3	. .	95.3	51	9	46	77.8	30	30	14	23.4
	4	40	20	. .	66.7	50	10	47	78.5	34	26	24	40.00
12"	1	30	0	All	100.00	28	2	23	77.0	21	9	19	13.5
	2	30	0	. .	100.00	30	0	13	43.5	19	11	17	57.0
	3	30	0	. .	100.00	23	7	17	57.0	28	2	26	86.5
	4	30	0	. .	100.00	28	2	11	36.5	26	4	25	83.5

* % Bolting June 19 in terms of original stand.

The seed-to-seed planting shows the highest rate of survival and maximum bolting. The stalks from roots that were planted 3 inches apart are much smaller in diameter and this may facilitate harvesting. This series is the most promising and generally shows vigorous growth.

The fall transplanting shows loss in survival of plants and in bolting, but it compares favorably with the spring planted series. The spring planting with 3-inch spacing shows a particularly high death rate, while the 12-inch spacing shows poor bolting.

The fall transplanting was rather late in the season (November 19) and earlier transplanting may increase the rate of survival.

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SUMMARY

Based upon one or two years' study at the Oregon State College Experiment Station the indications are that some of the following practices are desirable for vegetable seed production. (The experiments were conducted on Coarse Sandy Loam, Chehalis Loam and Willamette Silty Clay Loam.)

I. Cabbage

a. Cover crop, should be used particularly in flooded areas. The rye (Giant Winter) may be drilled between rows leaving a space of 10-16 inches clear on either side of the row. It is desirable to sow this cover crop about October 1.

b. Cabbage for seed production has responded most to complete fertilization (5-10-10), which was placed 7 inches directly beneath the row in the fall. Nitrogen was most important of the mineral fertilizers used. A desirable application of this mineral is 50 lbs. N. in the fall and at least 50 lbs. in the early spring. If phosphorus, potash, sulfur, and borax are used, they should be applied in the fall.

c. Many early varieties are more susceptible to winter injury than the late varieties, particularly when sown early.

d. Growth accelerating fertilizers are useful in increasing bolting and seed production on delayed seedings in the summer, or late transplantings in the fall.

e. It is advantageous to select only the large plants for transplantings made after October 1. For medium early (F.M. Market) varieties it is desirable to select stem sizes of at least 1/2 inch. Late varieties should probably average somewhat larger at that time. Heavy fertilization is desirable for such transplantings.

f. Seed-to-seed production will permit postponement of planting of about 3-4 weeks in the Willamette Valley.

Table Beets

a. Last year, covered fall transplanted roots survived as well as spring transplanted roots, and large fall transplanted roots survived better than small transplanted roots.

b. Rows held for random seed-to-seed study did not survive as well as the large roots fall transplanted.

Parsnips

Seed-to-seed production gave better survival than fall transplanted roots. Fall transplanting was more desirable than spring transplanting.

Spinach

During the past year, the results on the fertilizer experiments indicated that for spring spinach application of nitrogen was desirable. Phosphorus and potash did not give a response.

Onions

Fall planting of onions for seed was more desirable than a spring planting. Nitrogen is most important of the elements. Addition of lime in the fall improved yield of seed.

Radish

Results of two years of experimentation in spring seeded radishes indicate that the seed yield was low, even if large quantities of fertilizers were added.

In all experiments 30 lbs. of sulfur/A and 30 lbs. of borax/A were added to the fertilizer to assure that these were not limiting elements.